Zirconia Rehabilitation Focused on the Emergence Profile: A Case Report

Keywords

Ceramic
Lithium Disilicate
Anterior Crowns
Zirconia Abutments

Authors

Alfredo Mikail Melo Mesquita*
(DDS, MS, PhD)

Alberto Noriyuki Kojima§
(DDS, MS, PhD)

Elcio Madaglena Giovani#
(DDS, MS, PhD)

Cintia Helena Coury Saraceni#
(DDS, MS, PhD)

Flávia Pires Rodrigues#
(DDS, MS, PhD)

Address for Correspondence

Flávia Pires Rodrigues#

Email: flavia.rodrigues@unip.br
flapiro@gmail.com

* School of Dentistry, Paulista University - UNIP, São Paulo, SP, Brazil. R. Dr. Bacelar 1212, Vila Clementino, São Paulo, SP, 04026-002, Brazil

§ School of Dentistry, Univ. Estadual Paulista - ICT - UNESP - São José dos Campos, SP, Brazil.. Av. Francisco Jose Longo, 777, São José dos Campos, SP, 12227-000, Brazil

\# School of Dentistry, Paulista University - UNIP, São Paulo, SP, Brazil.
R. Dr. Bacelar 1212, Vila Clementino, São Paulo, SP, 04026-002, Brazil

Received: 08.09.15
Accepted: 16.03.16

doi: 10.1922/EJPRD_1521Rodrigues08

ABSTRACT

The first choice for anterior rehabilitation has been metal-free materials due to their successful aesthetic results. However, the definitive clinical work accuracy may be affected by the lack of clinicians' expertise and familiarization with the latest techniques, as well as recurrent laboratory procedures. This manuscript presents a clinical experience with zirconia ceramic for anterior crowns and zirconia CAD/CAM abutments, including both clinical and laboratory steps after the implant installation. The 'emergence profile' and the 'double scanning' techniques obtained by the waxing technique appear to be a very promising procedure for aesthetic improvement of the single-implant zirconia restoration in anterior teeth.

INTRODUCTION

The increase in aesthetic requests from patients at dental offices has been frequently associated with the poor aesthetics promoted by metal-ceramic prostheses and most recently to allergenic effects.[1, 2] Several metal-free ceramic systems have been developed for the dental market in the last years,[3-8] drawing patients and clinicians' attention to: color stability, low thermal conductivity, abrasion resistance and biocompatibility.[5, 6, 9-13] However, when ceramics are not supported by a metallic infrastructure, they are intensively affected by the crack propagation or even a full fracture.[3, 6, 14]

Several advances in their composition and processing techniques have been developed to minimize the friability and to improve ceramic materials,[4-6, 13, 15] and to achieve aesthetics and better mechanical properties. In this scenario, the zirconia-based material has been the choice of the prosthetic dentistry when excellent mechanical and chemical properties are the targets.

Considering that the peri-implant soft tissues morphology in anterior areas is not flat, the emergence prosthetic profile should then reproduce the natural soft tissue scalloping. The use of stock abutment may result in a round shaped mucosa, with an emergence profile lacking natural appearance. Conversely, an anatomical implant abutment shape may help support the surrounding soft tissues; also, this aspect may influence the stability of the buccal peri-implant soft tissues.[16]

There is still some difficulties from the clinician and technician to achieve a correct emergence profile because many horizontal compressions will appear around the pillar. These compressions are usually responsible for the vertical retraction and the incorrect and very current emergence profile acquisition, which would suggest a technique using a previous waxing

and a double scanning technique for controlling the gingival compression and the ceramic thicknesses. The present manuscript aims to describe a clinical experience of zirconia CAD/CAM abutment and crowns made with the 'double scanning' technique with the objective of providing dental aesthetics and mechanical support for the soft tissue after implants installation.

CASE REPORT

A 63-years-old female patient in excellent health conditions reported aesthetic discomfort at the anterior region. After discussing all possibilities of treatment with the patient, the choice were the implants with cone-morse connections on teeth #7 and #10 followed by metal-free zirconia abutments and total crown restorations. The periapical radiographic images in Figure 1 – A and B illustrate the implants already installed and the Figure 1 – C shows the clinical aspect after it. The present treatment report describes the prosthetic rehabilitation sequence after the implant surgery.

Figure 1: (A) and (B) Periapical radiograph images and intraoral pre-prosthetic treatment photograph of the patient showing teeth #7 and #10 with implants with cone-morse connections at (Flash 3.5 x 13 mm – Conexão Prosthetic System, Brazil); (C) The clinical aspect after the implants' installation

The patient signed a consent treatment term. The clinical treatment sequence was divided into five sessions, as follows:

Diagnostic procedures, wax-up and provisional restorations

In the first clinical session, occlusion was analyzed, and several photographs were taken to analyze the aesthetic and functional condition of the remaining adjacent teeth, evaluation of the anterior guidance, aesthetic profile and smile harmony. The initial appearance is illustrated in Figure 1, showing healthy dental tissue appearance after six-month of implant installation. Initial impressions were taken through the closed tray impression technique using addition silicone material The shade of the crowns was determined as A2 according to the VITA shade guide

The model was obtained with Type IV gypsum and artificial gingiva with the analogous of the implant platform, a diagnostic wax-up was made with the last configuration *(Figure 2*). An initial silicone guide was made to evidence the amount of the metallic UCLA abutment to be removed *(Figure 3* – A) and the inclination of the future zirconia crown *(Figure 3* – B). The metallic UCLA abutment reduction was completed for both future lateral crowns and double checked with the silicone guide *(Figure 4 – A*). In this phase, UCLAs were filled with resin for wax abutment building. It was also possible to observe and to preview the need for palatal or buccal reorientation of the metallic UCLAs *(Figure 4 – B*).

UCLAs were then personalized in a next waxing step and repositioned in the individual model *(Figure 5-A*) and also in the total cast *(Figure 5 – B*) for a new inclination check and a complete preview with the gingival support.

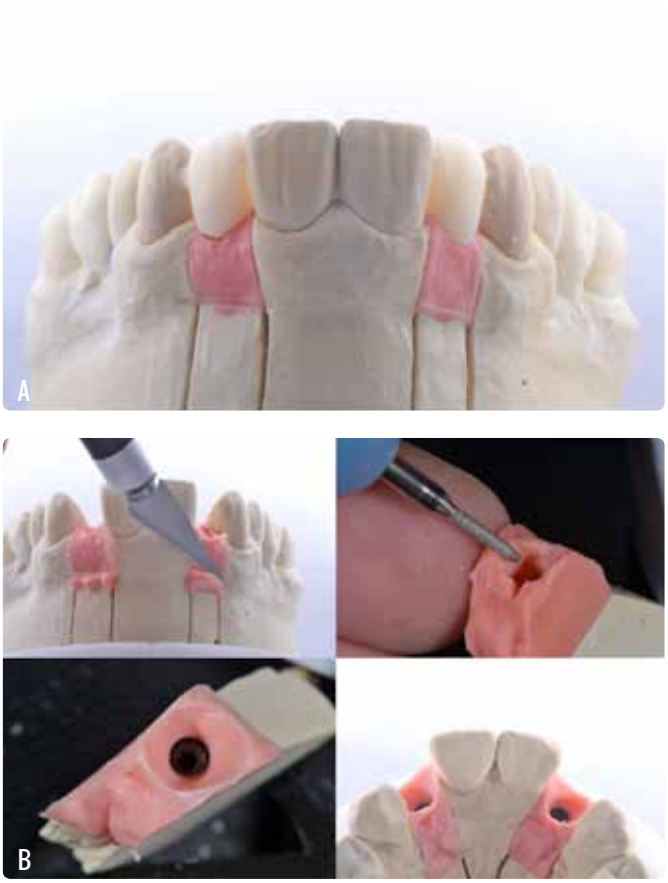

Figure 2: (A) Diagnostic waxing –up of teeth #7 and #10. (B) Sculpture of the artificial gum with a blade nº11 and a diamond bur to create the correct emergence profile.

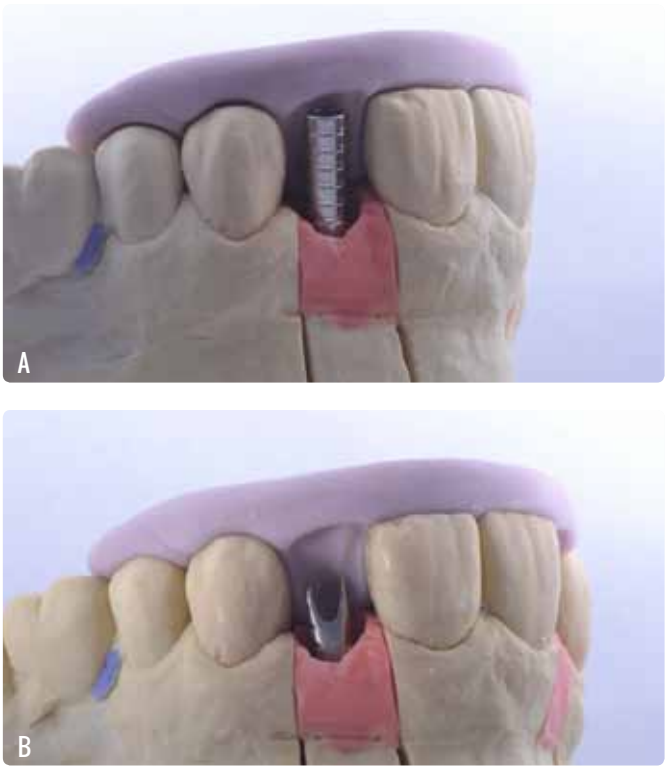

Figure 3: Silicone guide obtained to reduce the metal UCLA abutment: (A) before metallic UCLA reduction and (B) after metallic UCLA reduction.

Figure 4: (A) Front view UCLAS reduction of teeth #7 and #10 by the silicone guide and (B) Resin-filled UCLAS for wax abutment building.

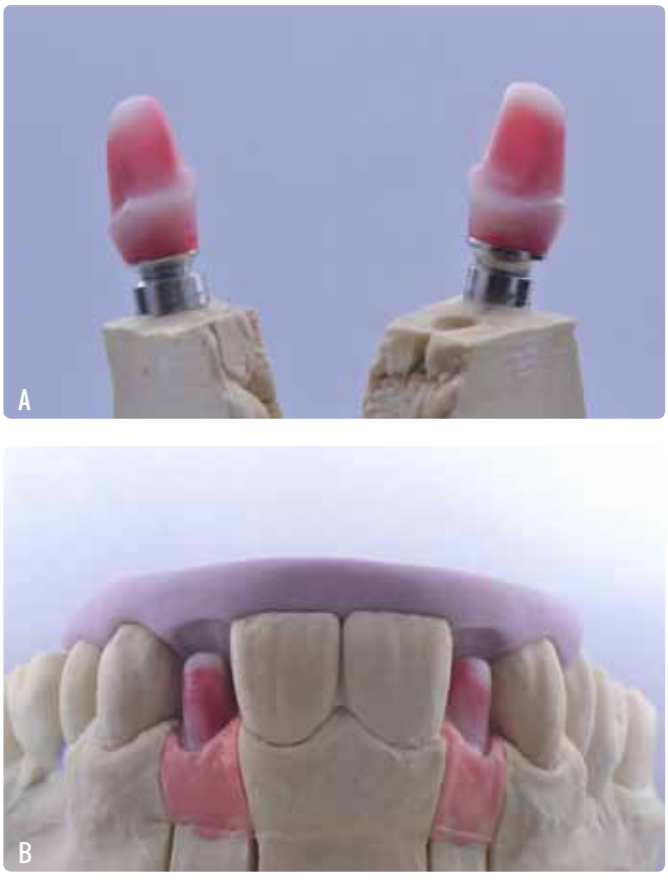

Figure 5: (A) Personalized abutment waxing and (B) UCLAs waxing positioned for check using the silicone guide and the gingival support.

Ceramic restorations

In special for this clinical treatment, the 'double scanning' technique was used, with Ceramill Motion 2, CAD/CAM system. First, the resin-filled metal structure was scanned and subsequently, the waxed abutments were scanned *(Figure 6 – A and B)*.

Using software design, the abutment delimitation for the edge of the coping and insertion axis were then determined *(Figure 7 – A)* and the designated area for the virtual waxing-up (drawing of the coping to be milled) *(Figure 7 – B)* could be defined. Internal *(Figure 8 – A)* and external (Figure – *B*) checking of the coping were also performed.

After the zirconia was milled, the UCLAS were ready for supra-structure cementation *(Figure 9 – A)*. Supra-structures were then cemented onto the metallic bases with the resin-cement *(Figure 9 – B)*. With both zirconia copings and abutments ready, space verification for the ceramic covering was made with the silicon guide *(Figure 10 – A and B)*. For the definitive form, with aesthetic onto zirconia copings, nano-fluorapatite ceramic was applied.

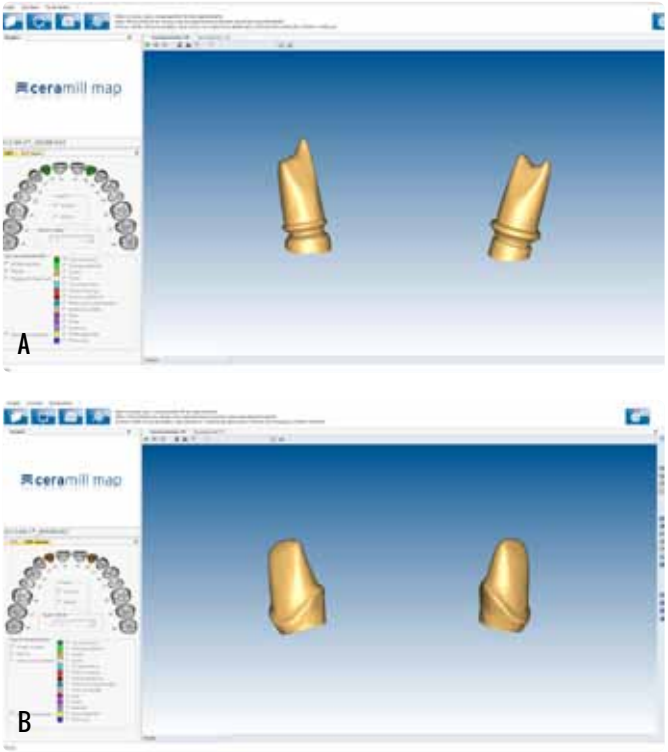

Figure 6: (A) Scanning of the metal structure filled with resin before the abutment scanning and (B) abutment scanning after waxing.

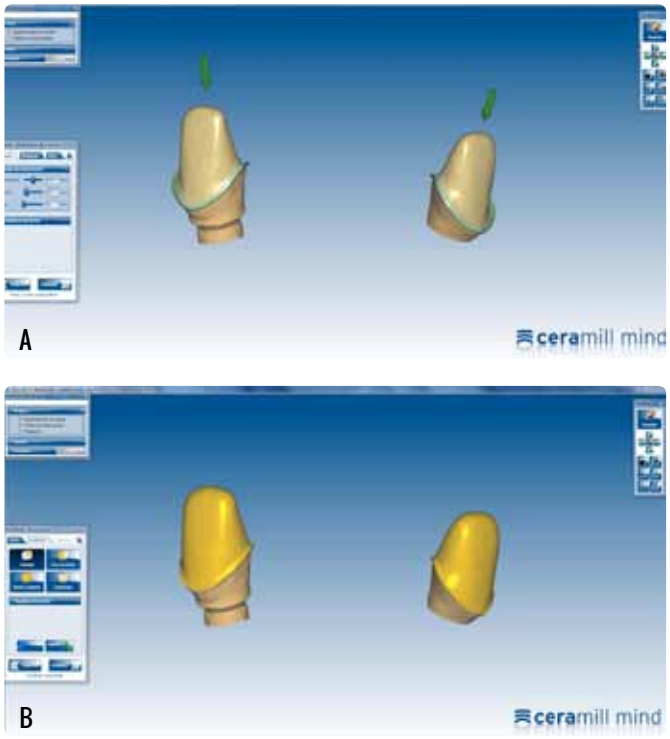

Figure 7: (A) Abutment delimitation for the edge coping and (B) drawing of the coping to be machined.

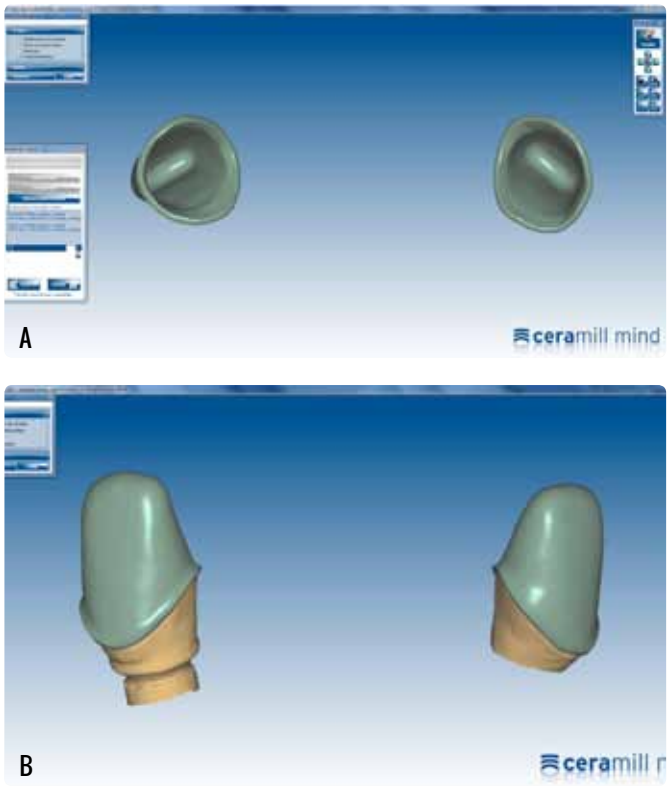

Figure 8: (A) Internal coping check and (B) external coping check.

Figure 9: (A) UCLAS ready for supra-structure in zirconia cementation and (B) supra-structures cemented onto metallic bases with the resin-cement.

Figure 10: (A) Zirconia copings and abutments ready for verification and (B) space verification for the ceramic covering checked with the silicon guide.

Clinical procedures: cementation and follow-up

In the second session, the abutments were positioned for accuracy, inclination and aesthetics check of the cervical region *(Figures 11 and 12 – A and B)*. The ceramic restorations were positioned before cementation and interproximal contacts were verified. The abutments were screwed onto the implants with 20 Ncm torque using proper implant torque wrench, following manufacturer's instructions manual. The abutment surface was treated with phosphoric acid 35% followed by water cleansing with the adjacent teeth protected by a Teflon® ribbon. The ceramic restorations were cemented using the dual-polymerized resin-based luting cement.

At the end of this session, the intercuspation *(Figure 8 – A)* was evaluated. An incisal view *(Figure 8 – B)* highlighted the superior arch harmony. As a result, it was possible to observe the morphological smile harmony, healthy periodontal tissues condition and occlusion *(Figure 13 – A and B)* and the patient's satisfaction *(Figure 14)*. The patient received postoperative care instructions and recall appointments were scheduled.

Figure 11: (A) Proof of the abutment of tooth #7 and (B) cementation of the final crown.

Figure 12: (A) Proof of the abutment of tooth #10 and (B) cementation of the final crown.

Figure 13: Definitive crowns view: (A) intercuspation and (B) anterior view.

Figure 14: Smile harmony and patient's satisfaction.

DISCUSSION

Since the CEREC system was introduced, several techniques were used for accuracy improvement of dental prostheses, such as single implant scans using a hand-scan unit, reverse engineering (wax-up pattern scan of the definitive restoration) and, most recently, the 'double scanning' method. In this method, the first scan captures the surface and the implant position while the second scan captures the pre-waxed definitive restoration.[17]

In the present study, two zirconia abutments and crowns obtained with the double scanning technique were described. The technique could be used to produce complicated zirconia copings with CAD-CAM to get the definitive restoration with proper equal porcelain length. During this process, the scanning software can overlay the two sets of data, fitting the virtual restoration to the laboratory analogs. This precision can be promoted due to the characteristic of a contact scanner when compared to an optical scanner,[17] which can contribute to generating better margin interfaces fit and also prevent fracture, chipping, and any other common ceramic failures.

Fractures in zirconia abutments have been reported,[18-20] the reason this type of rehabilitation applied to posterior teeth remains questionable.[21] On the other hand, zirconia abutments have been attracting attention due to high cumulative success rates in clinical trials. A recent 11-years clinical trial showed a cumulative success rate of 96.3% for abutments and 90.7% for crowns, suggesting that customized zirconia single implant abutments exhibit excellent long-term outcomes in anterior (and premolar) regions.[22] Another recent study has shown that the superstructure-geometry could be the main reason for the fractural behavior of the zirconia abutments[23] and not only the material itself. In a study considering three different types of abutments (n=20), some authors revealed that both zirconium and metallic implant abutments showed they can withstand clinical loads above normal mastication range[24] Although alumina abutments have already been used for the same purpose, some authors reported that some of them fractured after two years of loading charge, which makes zirconia abutments, with their superior mechanical properties, an alternative for supporting single-tooth implant restorations in the aesthetic zone.[25]

For the present study, the geometry and the angulation were checked and planned to avoid future fracture of both core and crown materials, as the implant angulation seemed to play a significant role in the treatment. A previous study recommends implant angulation lower than 30 degrees to improve fracture resistance of overlaying CAM-milled zirconia single crowns.[26] Another study which investigated the clinical performance of cemented customized zirconia abutments suggested that metallic-zirconia abutments may be comparable to currently available aesthetic implant abutments[15] and good clinical outcomes from all-ceramic single-tooth implant restorations have also been reported.[27, 28] The customization of the metallic pillar in the current study was made because when pre-fabricated metallic structures are used, the metallic structure remains with a lower height, providing lower retention to a supra-structure of zirconia. Moreover, the implant system used does not offer a metallic link option, and the gingival biotype as seen in Figure 1 is very slender.

Researchers and clinicians have been concerned about the influence of the abutment material on the color of the peri-implant soft tissues[29-31] to achieve result excellence. Therefore, simplified but efficient laboratory and clinical procedures are fundamental to the treatment planning success. However, despite the previous knowledge about the difference in the peri-implant soft tissue color if compared to the soft tissue color around natural teeth, notwithstanding which type of restorative material is selected, titanium abutment has been presenting lower aesthetics than gold or zirconia abutments.[29] In the present study, even though the rehabilitation of tooth #7 had a lower thickness of peri-implant soft tissue available, both teeth presented very similar definitive aesthetic appearance. This aspect corroborates to the finding of the recent studies mentioned,[30, 31] showing that the thickness of the peri-implant soft tissue does not seem to be an essential factor in the abutment impact on the soft tissue color.[29] Hence, another advantage of the double scanning technique used in the present study was to guarantee the marginal cervical accuracy of the abutment and the crown to improve aesthetics, which can be acknowledged in the results.

SUMMARY

The double scanning technique and the emergence profile obtained by the waxing technique appear to be a very promising procedure to improve the aesthetic of the single-implant zirconia restoration in anterior teeth.

MANUFACTURERS' DETAILS

- Implants: Flash 3.5 x 13 mm – Conexão Prosthetic System, Brazil;
- Impression material: Virtual, Ivoclar Vivadent, Schaan, Liechtenstein;
- Shade guide: Vitapan 3D Master®, VITA, Germany;
- Gypsum: Super Rock®, Noritake, Tokyo, Japan;
- Artificial gingiva: Gingifast Rigid®, Zhermack, Badia Polesine, Italy;
- Silicone guide: Zetalabor®, Zhermack, Badia Polesine, Italy;
- Resin: Pattern Resin LS®, GC, Alsip, Illinois, USA;
- Ceramil Motion 2, CAD-CAM system: Amann Girrbach®, Voralberg, Austria;
- Resin-cement: Panavia®, Japan, Kuraray;
- Ceramic: IPS e.max Ceram®, Ivoclar Vivadent, Schaan, Liechtenstein;
- Torquimeter: Conexão Sistemas de Prótese, São Paulo, Brazil;
- Luting cement: U200® (3M ESPE, St. Paul, Minnesota, USA;
- Cerec system: Sirona®, Bensheim, Germany;

REFERENCES

1. Morris HF. Veterans Administration Cooperative Studies Project No. 147. Part IV: Biocompatibility of base metal alloys. *J Prosthet Dent*., 1987;**58**:1.5.
2. Wang RR, Fenton A. Titanium for prosthodontic applications: a review of the literature. *Quintessence Int*., 1996;**27**:401.8.
3. Johansson C, Kmet G, Rivera J, Larsson C, Vult Von Steyern P. Fracture strength of monolithic all-ceramic crowns made of high translucent yttrium oxide-stabilized zirconium dioxide compared to porcelain-veneered crowns and lithium disilicate crowns. *Acta Odontol Scand*., 2014;**72**:145.53.
4. Pilathadka S, Vahalova D, Vosahlo T. The Zirconia: a new dental ceramic material. An overview. *Prague Med Rep*. 2007;**108**:5-12.
5. Touati B. Innovative dental ceramics: expanding the material alternatives. *Pract Proced Aesthet Dent*., 2005;**17**:357.8.
6. Guazzato M, Proos K, Quach L, Swain MV. Strength, reliability and mode of fracture of bilayered porcelain/zirconia (Y-TZP) dental ceramics. *Biomaterials*., 2004;**25**:5045.52.
7. Bieniek KW, Marx R. The mechanical loading capacity of new all-ceramic crown and bridge materials. *Schweiz Monatsschr Zahnmed*., 1994;**104**:284.9.
8. Castellon P, Potiket N, Soltys JL, Johnson J, Zavala J. All-ceramic restorative system for esthetic implant-supported crowns: in vitro evaluations and clinical case report. *Compend Contin Educ Dent*., 2003;**24**:673.6.
9. Protopapadaki M, Monaco EA, Jr., Kim HI, Davis EL. Comparison of fracture resistance of pressable metal ceramic custom implant abutment with a commercially fabricated CAD/CAM zirconia implant abutment. *J Prosthet Dent*., 2013;**110**:389.96.
10. Marrelli M, Maletta C, Inchingolo F, Alfano M, Tatullo M. Three-point bending tests of zirconia core/veneer ceramics for dental restorations. *Int J Dent*., 2013;**2013**:831976.
11. Lin WS, Ercoli C, Feng C, Morton D. The effect of core material, veneering porcelain, and fabrication technique on the biaxial flexural strength and weibull analysis of selected dental ceramics. *J Prosthodont*., 2012;**21**:353.62.
12. Mitov G, Gessner J, Lohbauer U, Woll K, Muecklich F, Pospiech P. Subcritical crack growth behavior and life data analysis of two types of dental Y-TZP ceramics. *Dent Mater*., 2011;**27**:684.91.
13. Hsueh CH, Luttrell CR, Becher PF. Analyses of multilayered dental ceramics subjected to biaxial flexure tests. *Dent Mater*., 2006;**22**:460.9.

14. Oilo M, Hardang AD, Ulsund AH, Gjerdet NR. Fractographic features of glass-ceramic and zirconia-based dental restorations fractured during clinical function. *Eur J Oral Sci.*, 2014;**122**:238.44.
15. Canullo L. Clinical outcome study of customized zirconia abutments for single-implant restorations. *Int J Prosthodont.*, 2007;**20**:489.93.
16. Parpaiola A, Norton MR, Cecchinato D, Bressan E, Toia M. Virtual abutment design: a concept for delivery of CAD/CAM customized abutments-- report of a retrospective cohort. *Int J Periodontics Restorative Dent.*, 2013;**33**:51.8.
17. Liu YH, Feng HL, Wang HT, Wang L, Nie YG, Wang T. Double scanning method for computer aided design and computer aided manufacture all-ceramic restorations. *Zhonghua Kou Qiang Yi Xue Za Zhi.*, 2010;**45**:168.71.
18. Villa R, Crespi R, Cappare P, Gherlone E. Immediate loading of a dental implant placed in fresh socket with acute dehiscence-type defect: a clinical case report. *J Periodontol.*, 2010;**81**:953.7.
19. Kim S, Kim HI, Brewer JD, Monaco EA, Jr. Comparison of fracture resistance of pressable metal ceramic custom implant abutments with CAD/CAM commercially fabricated zirconia implant abutments. *J Prosthet Dent.*, 2009;**101**:226.30.
20. Passos SP, Linke B, Larjava H, French D. Performance of zirconia abutments for implant-supported single-tooth crowns in esthetic areas: a retrospective study up to 12-year follow-up. *Clin Oral Implants Res.*, 2014. vol. n/a.
21. Boff LL, Oderich E, Cardoso AC, Magne P. Fatigue resistance and failure mode of adhesively restored custom metal-composite resin premolar implant abutments. *Int J Oral Maxillofac Implants.*, 2014;**29**:364.73.
22. Zembic A, Philipp AO, Hammerle CH, Wohlwend A, Sailer I. Eleven-Year Follow-Up of a Prospective Study of Zirconia Implant Abutments Supporting Single All-Ceramic Crowns in Anterior and Premolar Regions. *Clin Implant Dent Relat Res.*, 2014. vol. n/a.
23. Nothdurft FP, Neumann K, Knauber AW. Fracture behavior of zirconia implant abutments is influenced by superstructure-geometry. *Clin Oral Investig.*, 2014;**18**:1467.72.
24. Aramouni P, Zebouni E, Tashkandi E, Dib S, Salameh Z, Almas K. Fracture resistance and failure location of zirconium and metallic implant abutments. *J Contemp Dent Pract.*, 2008;**9**:41.8.
25. Chen ZF, Nang PH, Wang Y, Luo ZB. Clinical evaluation of ceramic implant abutments in anterior restorations. *Ann R Australas Coll Dent Surg.*, 2008;**19**:67.70.
26. Ellakwa A, Raj T, Deeb S, Ronaghi G, Martin FE, Klineberg I. Influence of implant abutment angulations on the fracture resistance of overlaying CAM-milled zirconia single crowns. *Aust Dent J.*, 2011;**56**:132.40.
27. Schiroli G. Single-tooth implant restorations in the esthetic zone with PureForm ceramic crowns: 3 case reports. *J Oral Implantol.*, 2004;**30**:358.63.
28. Glauser R, Sailer I, Wohlwend A, Studer S, Schibli M, Scharer P. Experimental zirconia abutments for implant-supported single-tooth restorations in esthetically demanding regions: 4-year results of a prospective clinical study. *Int J Prosthodont.*, 2004;**17**:285.90.
29. Bressan E, Paniz G, Lops D, Corazza B, Romeo E, Favero G. Influence of abutment material on the gingival color of implant-supported all-ceramic restorations: a prospective multicenter study. *Clin Oral Implants Res.*, 2011;**22**:631.7.
30. Happe A, Schulte-Mattler V, Fickl S, Naumann M, Zoller JE, Rothamel D. Spectrophotometric assessment of peri-implant mucosa after restoration with zirconia abutments veneered with fluorescent ceramic: a controlled, retrospective clinical study. *Clin Oral Implants Res.*, 2013;**24** (Suppl A100):28.33.
31. Watkin A, Kerstein RB. Improving darkened anterior peri-implant tissue color with zirconia custom implant abutments. *Compend Contin Educ Dent.*, 2008;**29**:238.40, 42.