Zirconia implant abutments: A review.

Gomes AL, Montero J.


Department of Surgery, University of Salamanca, C/ Alfonso X el Sabio. S/N, Campus Unamuno, 37007 Salamanca, Spain, javimont@usal.es.

Abstract

Objectives: An increasing aesthetic demand within developed populations conducted to the fabrication of metal-free restorations and to a wide use of ceramic materials, due to its excellent characteristics of biocompatibility and aesthetics. With the incessant increase of commercial labels involved in this technological advance, a review is imposed on ceramic abutments, specifically on zirconia. We made a search of articles of peer-reviewed Journals in PubMed/Medline, crossing the terms "Dental Abutments", "Dental Porcelain" and "Zirconia". The review was divided by subtopics: zirconia physical and mechanical properties, precision fit in the implant-abutment interface, zirconia abutments strength and, finally, bacterial adherence and tissues response. Several studies demonstrate that zirconia abutments offer good results at all the levels but relevant issues need further studies and evaluation. One of the most important is the clinical long term success of zirconia abutments on implants, given that in the literature there are no sufficient in vivo studies that prove it.

Artikel frei zugänglich unter: http://www.medicinaoral.com/medoralfree01/aop/20526253.pdf

A systematic review of the performance of ceramic and metal implant abutments supporting fixed implant reconstructions.

Sailer I, Philipp A, Zembic A, Pjetursson BE, Hämmerle CH, Zwahlen M.


Clinic for Fixed and Removable Prosthodontics and Dental Material Science, University of Zurich, Zurich, Switzerland. irena.sailer@zzmk.uzh.ch

Comment in:


Abstract
OBJECTIVES: The objective of this systematic review was to assess the 5-year survival rates and incidences of complications associated with ceramic abutments and to compare them with those of metal abutments.

METHODS: An electronic Medline search complemented by manual searching was conducted to identify randomized-controlled clinical trials, and prospective and retrospective studies providing information on ceramic and metal abutments with a mean follow-up time of at least 3 years. Patients had to have been examined clinically at the follow-up visit. Assessment of the identified studies and data abstraction was performed independently by three reviewers. Failure rates were analyzed using standard and random-effects Poisson regression models to obtain summary estimates of 5-year survival proportions.

RESULTS: Twenty-nine clinical and 22 laboratory studies were selected from an initial yield of 7136 titles and data were extracted. The estimated 5-year survival rate of ceramic abutments was 99.1% [95% confidence interval (CI): 93.8-99.9%] and 97.4% (95% CI: 96-98.3%) for metal abutments. The estimated cumulative incidence of technical complications after 5 years was 6.9% (95% CI: 3.5-13.4%) for ceramic abutments and 15.9% (95% CI: 11.6-21.5%) for metal abutments. Abutment screw loosening was the most frequent technical problem, occurring at an estimated cumulative incidence after 5 years of 5.1% (95% CI: 3.3-7.7%). All-ceramic crowns supported by ceramic abutments exhibited similar annual fracture rates as metal-ceramic crowns supported by metal abutments. The cumulative incidence of biological complications after 5 years was estimated at 5.2% (95% CI: 0.4-52%) for ceramic and 7.7% (95% CI: 4.7-12.5%) for metal abutments. Esthetic complications tended to be more frequent at metal abutments. A meta-analysis of the laboratory data was impossible due to the non-standardized test methods of the studies included.

CONCLUSION: The 5-year survival rates estimated from annual failure rates appeared to be similar for ceramic and metal abutments. The information included in this review did not provide evidence for differences of the technical and biological outcomes of ceramic and metal abutments. However, the information for ceramic abutments was limited in the number of studies and abutments analyzed as well as the accrued follow-up time. Standardized methods for the analysis of abutment strength are needed.

Marginal adaptation of all-ceramic crowns on implant abutments.

Att W, Hoischen T, Gerds T, Strub JR.


Department of Prosthodontics, University Hospital of Freiburg, Freiburg, Germany. wael.att@uniklinik-freiburg.de

Abstract

BACKGROUND: Studies focusing on the marginal accuracy of all-ceramic crowns on implant abutments are in short supply.

PURPOSE: This study evaluated the marginal accuracy of all-ceramic crowns on different implant abutments.
MATERIALS AND METHODS: Ninety-six standardized maxillary central incisor crowns (48 alumina and 48 zirconia) were fabricated for each of the six test groups (n = 16) (Ti1, titanium abutments-alumina crowns; Ti2, titanium abutments-zirconia crowns; Al1, alumina abutments-alumina crowns; Al2, alumina abutments-zirconia crowns; Zr1, zirconia abutments-alumina crowns; Zr2, zirconia abutments-zirconia crowns). The crowns were adhesively luted using a resin luting agent. The marginal gaps were examined on epoxy replicas before and after luting as well as after masticatory simulation at 200x magnification.

RESULTS: The geometrical mean (95% confidence limits) marginal gap values before cementation, after cementation, and after masticatory simulation were group Ti1: 39(37-42), 57(53-62), and 49(46-53); group Ti2: 43(40-47), 71(67-76), and 64(59-69); group Al1: 57(54-61), 87(85-90), and 67(65-69); group Al2: 66(63-69), 96(90-101), and 75(72-78); group Zr1: 54(51-57), 79(76-82), and 65(63-67); and group Zr2: 64(60-68), 85(80-91), and 75(70-81). The comparison between non-cemented and cemented stages in each group demonstrated a significant increase in the marginal gap values after cementation in all groups (p < .001), while the comparison between cemented and aged stages in each group showed a significant decrease in the marginal gap values in groups Al1, Al2, and Zr1 (p < .0001). This reduction was not significant for groups Ti1, Ti2, and Zr2 (p > .05).

CONCLUSION: The marginal accuracy of all tested restorations meets the requirements for clinical acceptance.

The implant-abutment interface of alumina and zirconia abutments.

Yüzügüllü B, Avci M.


Department of Prosthodontics, Faculty of Dentistry, Hacettepe University, 06100 Sihhiye, Ankara, Turkey. bulemy@gmail.com

Abstract

BACKGROUND: Although ceramic and titanium abutments are widely used in clinical practice, the mechanical characterization of the implant-abutment interface for ceramic abutments has not been evaluated after the dynamic loading.

PURPOSE: The purpose of this study was to assess the implant-abutment interface after the dynamic loading of titanium, alumina, and zirconia abutments.

MATERIALS AND METHODS: Fifteen aluminum oxide, zirconium oxide, and titanium abutments were manufactured by the Procera System (Nobel Biocare AB, Göteborg, Sweden) and were connected to Ø 3.75 x 13-mm regular platform implants (MK III, Nobel Biocare AB) secured in a 30 degrees inclined plane. A mechanical testing machine applied compressive dynamic loading between 20 and 200 N at 1 Hz on a standard contact area of copings cemented on abutments for 47,250 cycles. The measurements of microgaps at the implant-abutment interface from the labial, palatinal, mesial, and distal surfaces of each specimen were undertaken by scanning electron microscope analyses prior to and after the experiments. The data of the microgaps before and after the dynamic loading were
statistically assessed using the Wilcoxon signed rank test and the Kruskal-Wallis variance analysis (alpha = 0.05).

RESULTS: Coping fracture, abutment fracture, or abutment screw loosening or fracture was not detected in any specimen during the entire test period. After the dynamic loading, the titanium abutment control group revealed an increased microgap (3.47 microm) than zirconia (1.45 microm) and alumina (1.82 microm) groups at the palatinal site (p < .05). The mean measurement values at different measurement sites of specimens within and between each abutment group were similar (p > .05).

CONCLUSION: Owing to their comparable microgap values at the implant-abutment interface after the dynamic loading, ceramic abutments can withstand functional forces like conventional titanium abutments.

In vitro study of the influence of the type of connection on the fracture load of zirconia abutments with internal and external implant-abutment connections.

Sailer I, Sailer T, Stawarczyk B, Jung RE, Hämmerle CH.


Clinic for Fixed and Removable Prosthodontics and Dental Material Science, Center for Dental and Oral Medicine, University of Zurich, Switzerland. irena.sailer@zzmk.uzh.ch

Abstract

PURPOSE: To determine whether zirconia abutments with an internal connection exhibit similar fracture load as zirconia abutments with an external connection.

MATERIALS AND METHODS: The following zirconia abutments were divided into four groups of 20 each: StraumannCARES abutments on Straumann implants (group A), Procera abutments on Branemark implants (group B), Procera abutments on NobelReplace implants (group C), and Zirabut SynOcta prototype abutments on Straumann implants (group D). The abutments were fixed on their respective implants either internally via a secondary abutment (A) or a metallic coupling (C) (two-piece) or directly externally (B) and internally (D) (one-piece). In each group, 10 abutments were left unrestored (A1 to D1). Ten received glass-ceramic crowns (A2 to D2). Static loading was performed according to the ISO norm 14801 until failure. The bending moment was calculated for comparison of the groups and subjected to statistical analysis (Student t test).

RESULTS: The mean bending moments of the unrestored abutments were 371.5 +/- 142.3 Ncm (A1), 276.5 +/- 47.6 Ncm (B1), 434.9 +/- 124.8 Ncm (C1), and 182.5 +/- 136.5 Ncm (D1). Two-piece internally connected abutments exhibited higher bending moments than one-piece internally (C1 versus D1 P = .003, A1 versus D1 P = .03) or externally (C1 versus B1 P = .004) connected abutments. The groups with restorations did not show different bending moments than those without restorations. The mean bending moments of the restored abutments were 283.3 +/- 44.8 Ncm (A2), 291.5 +/- 31.7 Ncm (B2), 351.5 +/- 58 Ncm (C2), and 184.3 +/- 77.7 Ncm (D2). Group C2 exhibited the highest bending moment (P < .05). Internally connected one-piece abutments (D2) were weaker than all other groups (D2 versus A2 P = .002; D2 versus B2 P = .001; D2 versus C2 P = .0003).
CONCLUSIONS: The type of connection significantly influenced the strength of zirconia abutments. Superior strength was achieved by means of internal connection via a secondary metallic component.

Load fatigue performance of implant-ceramic abutment combinations.

Nguyen HQ, Tan KB, Nicholls JI.


Dental Department, Alexandra Hospital, Singapore.

Abstract

PURPOSE: The mechanical properties and functional load performance of implant restorations coupled with metal abutments have been studied widely. However, the fatigue performance of the newly introduced ceramic implant abutments has not been reported. This study investigated the load fatigue performance of four implant systems and their corresponding zirconia ceramic abutments at the manufacturers’ recommended torque levels.

MATERIALS AND METHODS: Three different diameters (narrow, regular, and wide) of the Replace Select and Branemark systems and two different diameters (4.1 mm and 5.0 mm) of the Osseotite NT and Osseotite NT Certain systems provided 10 implant-abutment test groups. The abutments tested were Procera zirconia, Zireal posts, and Certain ZiReal posts. Each group had a sample size of five. A rotational load fatigue machine applied a 21-N load to the specimens at an angle of 45 degrees to produce an effective bending moment of 35 Ncm at a test frequency of 10 Hz. The number of cycles to failure was recorded.

RESULTS: Twenty-nine of the 50 implant-abutment combinations tested failed. Eighteen abutments fractured. Seven implant fractures and 16 abutment screw fractures were seen, along with some damage to the implant platform in some specimens. No significant difference was seen between the implant systems, but significant differences were observed between the implant diameters. A subsequent one-way analysis of variance revealed statistically significant differences between the 10 implant-abutment test groups.

CONCLUSIONS: Rotational load fatigue testing performance of zirconia abutments is dependent on the abutment diameter. Failure modes varied according to system design characteristics.

Zirconium implant abutments: fracture strength and influence of cyclic loading on retaining-screw loosening.


peter_gehrke@yahoo.de
Abstract

OBJECTIVE: The purpose of this study was to determine the fracture strength of zirconium implant abutments and the torque required to unfasten the retaining screw before and after applying cyclic loading to the implant-abutment assembly. The dynamic behavior and stress distribution pattern of zirconium abutments were also evaluated.

METHODS AND MATERIALS: Static and cyclic loading of 7 XiVE implants with straight Cercon zirconium abutments were simulated under worst-case conditions. Cyclic loading tests were performed via a servohydraulic dynamic testing machine at loads between 100 and 450 N, for up to 5 million loading cycles, at 15 Hz. The dynamic behavior of the zirconium abutments was analyzed by finite element modeling and Pro/Mechanica software, comparing van-der-Mises and maximum stress levels.

RESULTS: Cercon zirconium-ceramic abutments exhibited a maximum fracture strength of 672 N during static loading and 269 N at 800,000 to 5 million cycles runout point, and 403 N at 10,000 cycles runout point during cyclic loading. The mean torque value required to unfasten the abutment retaining screws after (initial) tightening was 21 Ncm +/- 1 and 20 Ncm +/- 1 (measurement accuracy +/- 2 Ncm) after loading with up to 5 million cycles respectively. Torque values decreased minimally and screw loosening did not occur. Within the limited number of test specimens (7), the difference was statistically significant (P = .015). FEM analysis displayed higher stress peaks up to 800 MPa at the cervical aspect of the zirconium abutment and at the apical third of its retaining screw at an external load of 250 N.

CONCLUSION: Within the limitations of this study, zirconium implant abutments exceeded the established values for maximum incisal bite forces reported in the literature and tightly fit into the titanium implant after several millions of loading cycles.

Long-term survival and success of oral implants in the treatment of full and partial arches: a 7-year prospective study with the ITI dental implant system.

Romeo E, Lops D, Margutti E, Ghisolfi M, Chiapasco M, Vogel G.


Department of Prosthodontics, Dental Clinic, School of Dentistry, University of Milan, Via Beldiletto 1/3, 20142 Milano, Italy. eugenio.romeo@unimi.it

Abstract

PURPOSE: This study evaluated the long-term survival and success of different implant-supported prostheses supported by ITI implants.

MATERIALS AND METHODS: Two hundred fifty consecutive patients were rehabilitated using implant-supported prostheses. Seven hundred fifty-nine implants were loaded. Single-tooth prostheses (n = 106), cantilever fixed partial prostheses (n = 42), fixed partial prostheses (n = 137), fixed complete prostheses (n = 5), implant/tooth-supported prostheses (n = 13), and overdentures (n = 37) were used. The mean follow-up period was 3.85 years. Life table analyses were performed. Implant survival rates were calculated by means of
standard life table principles. Statistical analysis was performed to compare the implant survival and success by implant placement site for each type of prosthesis.

RESULTS: The cumulative implant survival rates were calculated for implants supporting single-tooth prostheses (95.6%), cantilever fixed partial prostheses (94.4%), fixed partial prostheses (96.1%), fixed complete prostheses (100%), implant/tooth-connected prostheses (90.6%), and overdentures (95.7%). Similar survival and success rates were documented for implants placed in maxillae and mandibles. Implant size did not influence survival.

DISCUSSION: Seven-year survival rates were similar for implants supporting single-tooth prostheses, cantilever fixed partial prostheses, fixed partial prostheses, and implant/tooth-supported prostheses. Medium-long term implant survival and success were not influenced by the site (maxilla or mandible). Implant and prosthetic survival rates for overdentures supported by 2 implants were comparable to those for overdentures supported by 3 or more implants.

CONCLUSION: Prostheses supported by ITI implants represent a reliable medium-term treatment. (More than 50 references.)

An overview of zirconia ceramics: basic properties and clinical applications.

Manicone PF, Rossi lommetti P, Raffaelli L.


Catholic University of Sacred Heart, Institute of Clinical Dentistry, Largo F.Vito 1, 00168 Rome, Italy.

Abstract

Zirconia (ZrO2) is a ceramic material with adequate mechanical properties for manufacturing of medical devices. Zirconia stabilized with Y2O3 has the best properties for these applications. When a stress occurs on a ZrO2 surface, a crystalline modification opposes the propagation of cracks. Compression resistance of ZrO2 is about 2000 MPa. Orthopedic research led to this material being proposed for the manufacture of hip head prostheses. Prior to this, zirconia biocompatibility had been studied in vivo; no adverse responses were reported following the insertion of ZrO2 samples into bone or muscle. In vitro experimentation showed absence of mutations and good viability of cells cultured on this material. Zirconia cores for fixed partial dentures (FPD) on anterior and posterior teeth and on implants are now available. Clinical evaluation of abutments and periodontal tissue must be performed prior to their use. Zirconia opacity is very useful in adverse clinical situations, for example, for masking of dischromic abutment teeth. Radiopacity can aid evaluation during radiographic controls. Zirconia frameworks are realized by using computer-aided design/manufacturing (CAD/CAM) technology. Cementation of Zr-ceramic restorations can be performed with adhesive luting. Mechanical properties of zirconium oxide FPDs have proved superior to those of other metal-free restorations. Clinical evaluations, which have been ongoing for 3 years, indicate a good success rate for zirconia FPDs. Zirconia implant abutments can also be used to improve the aesthetic outcome of implant-supported rehabilitations. Newly proposed zirconia implants seem to have good biological and mechanical properties; further studies are needed to validate their application.