



Marginal Fit Metal–Ceramic and In-Ceram Single Crown Cement retained in Implant-supported Abutments

¹Valdimar S Valente, ²Carlos E Francischone, ³CD Vilarinho Soares de Moura, ⁴CE Francischone Júnior
⁵Antonio M Silva, ⁶Izabella S Ribeiro, ⁷EM Maia Filho, ⁸Matheus C Bandéca, ⁹Mateus R Tonetto
¹⁰RR de Jesus Tavarez

ABSTRACT

Introduction: This study evaluated the cervical fit of cemented metal–ceramic and In-Ceram implant-supported crowns, before and after the cementing procedure.

Materials and methods: Twenty crowns cemented on implant abutments are divided into two groups (n=10): Group 1 – cemented metal–ceramic crowns and group 2 – cemented In-Ceram crowns. The marginal adaptations before and after cementation were evaluated in a comparison microscope with an error of 1 μ m. All crowns were cemented with zinc phosphate cement.

Results: The cervical misalignment of cemented crowns before cementation (52.65 ± 11.83 and 85.73 ± 14.06 μ m) was lower than that after cementation (66.80 ± 15.86 and 89.36 ± 22.66 μ m).

Conclusion: The cementing procedure interferes with the marginal fit of cemented crowns on implant abutments, with the prosthesis having better adaptation before cementation. Cemented metal–ceramic crowns exhibited better cervical adaptation than In-Ceram crowns cemented before and after the cementing procedure.

Clinical significance: The maintenance of gum health and the longevity of prosthetic restorations are closely related to the restoration's marginal integrity.

Keywords: Cementation, Marginal adaptation, Protheses and implants.

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INTRODUCTION

The need for new restorative materials has become more and more evident as the esthetic demands of society have evolved. Therefore, it is necessary for dental practitioners to develop restorative solutions that resemble natural teeth.

The maintenance of gum health and the longevity of prosthetic restorations are closely related to the restoration's marginal integrity and sealing ability. The important factors, such as the thickness of the cement film, the technique used to fabricate the restoration, and the professional skills needed to cement the restorations correctly, are relevant criteria for achieving better results.¹

The marginal adaptation between implant abutments and cemented implant-supported prostheses has a significant influence on the maintenance of healthy tissue around implants because, in most cases, the junction line between these components is located more subgingivally than those of conventional tooth-supported crowns. Thus,

^{1,3}Department of Prosthodontics and Restorative Dentistry Federal University of Piauí (UFPI), Teresina, Piauí, Brazil

²Department of Postgraduation, São Leopoldo Mandic University Campinas, São Paulo, Brazil

⁴Postgraduate Program of Sagrado Coração University, Bauru São Paulo, Brazil

⁵Department of Prosthodontics and Restorative Dentistry Federal University of Ceará (UFC), Fortaleza, Ceará, Brazil

^{6-8,10}Postgraduate Department, CEUMA University, São Luis Maranhão, Brazil

⁹Postgraduate Department, University of Cuiabá, Cuiabá, Mato Grosso, Brazil

Corresponding Author: RR de Jesus Tavarez, Postgraduate Department, CEUMA University, São Luis, Maranhão, Brazil Phone: +5598988283948, e-mail: rudysd@uol.com.br

it is essential that care be taken to control the variables that influence this prosthetic cervical adaptation because this determines the thickness of the cement line exposed to the oral environment, which may contribute to periodontal tissue inflammation. This exposed cement line, with its rough surface, is subject to dissolution and plaque adhesion, resulting in the growth of an inflammatory lesion in the mucosa next to the tooth or implant.² The passive fit of implant superstructures is an important factor that determines the long-term success of dental implant restorations.³

With the aim of improving the esthetic characteristics of the crown, dentistry has sought to eliminate the use of metal in these restorations. One of the metal-free prosthetic systems currently in widespread use involves a ceramic with the addition of alumina, namely the In-Ceram system, which has a superior resistance when compared with conventional dental ceramics and a greater esthetic quality, which makes it possible to fabricate a metal-free infrastructure when making ceramic crowns. While the patient is concerned with the cosmetic result, the professional is concerned with the accuracy of the

crown's marginal fit and the fracture resistance to ensure the longevity of his work.⁴ Thus, the purpose of this study was to evaluate the cervical adaptation of metal-ceramic and In-Ceram crowns when cemented to implanted metal abutments, both before and after the cementing procedure.

MATERIALS AND METHODS

Sample Preparation

Twenty crowns were fabricated on metal implant abutments. The crowns were of a standardized format and dimensions, similar to a premolar, and were randomly divided into two groups (n=10). Group 1 consisted of cemented ceramo-metal crowns (Figs 1A to C) made through the fabrication of a wax-up infrastructure template cast in a base metal alloy, cobalt–chromium–molybdenum (New Ceram, CNG, Brazil), and a feldspathic ceramic system (Duceram Kiss, DeguDent, Germany) as the veneering material. Group 2 consisted of In-Ceram crowns (Figs 2A to C) made with a 0.5 mm thick aluminum oxide infrastructure (Al₂O₃ In-Ceram Alumina, Vita Zahnfabrik, Germany), veneered with an alumina



Figs 1A to C: Group 1: (A) Implant metal abutment; (B) and (C) cemented ceramic–metal crown



Figs 2A to C: Group 2: (A) Implant metal abutment; (B) and (C) cemented In-Ceram crown

ceramic system (All Ceram Ducera, Germany). The abutments were obtained through the infrastructure wax-up and casting procedure using a base metal alloy, cobalt–chromium–molybdenum (New Ceram, CNG, Brazil). The implant analog/metal abutment sets were screwed manually, using a digital hex wrench, to 10 Ncm. The wrench was then attached to a torque meter (Tohnichi Torque Gage, Model BTG-60CN, 503912Y series), and the abutment screw received a tightening torque of 35 Ncm. After 5 minutes, the screw was retightened applying the same torque.

Marginal Analysis

Marginal accuracy was assessed by measuring the absolute marginal discrepancy of the crowns on the abutments. The marginal discrepancy of all the samples was measured at the four faces of the crown (buccal, lingual, mesial, and distal) using a precision microscope with a reading accuracy of 1 μm (Mitutoyo, Measuring Microscope, Model 505, TM-500 series, code 176-811, Tokyo, Japan). To standardize the marginal analysis, reference points were marked in advance in the middle of the buccal, mesial, lingual, and distal surfaces. This procedure was repeated three times before cementation, and the resulting mean was used.

Cementation

A zinc phosphate cement (SS White, Rio de Janeiro, Brazil) was used for the cementation of all crowns. After setting, cement was applied to the inner surface of the crown, which was positioned and set with an initial manual pressure that caused the excess material to overflow. A constant pressure of 1.0 kg was then applied and the excess was removed from the margins after 10 minutes. The samples were again placed on the microscope table to start a new sequence of three readings at the margin postcementation. The marginal fit was calculated by subtracting the final mean postcementation from the final mean precementation.

Statistical Analysis

The data obtained were submitted to analysis of normality and subsequently the t-test for paired samples was used for intragroup comparison before and after luting. The t-test for independent samples was used to compare between groups, both before and after cementation.

RESULTS

The mean values of the cervical adaptation are shown in Table 1. The intragroup analysis showed that there was a significant difference in the metal–ceramic crown

Table 1: Mean cervical adaptation (μm) and standard deviation (SD) values for implant-supported crowns before (B) and after (A) cementation

Specimen	Metal–ceramic crowns		In-Ceram crowns	
	B ^m	A ^m	B ^c	A ^c
1	60.83	73.25	77.75	102.33
2	59.67	84.25	83.25	92.92
3	55.33	65.67	96.00	127.67
4	67.17	84.08	104.67	111.08
5	71.33	91.08	80.83	92.14
6	45.42	55.53	93.42	77.58
7	40.67	48.33	58.92	56.00
8	42.33	54.92	89.17	60.17
9	37.33	46.50	72.00	100.60
10	46.42	64.42	101.33	73.08
Mean	52.65	66.80	85.73	89.36
SD	11.83	15.86	14.06	22.66

Significant difference between measurements B^m and A^m ($p < 0.001$); no significant difference between measurements B^c and A^c ($p > 0.05$); significant difference between measurements B^m and B^c ($p < 0.001$); significant difference between measurements A^m and A^c ($p < 0.05$)

group ($p < 0.001$); however, no significant difference was found in the In-Ceram crown group ($p = 0.619$). In the intergroup analysis, there was a significant difference between the groups both before ($p < 0.001$) and after cementation ($p < 0.05$).

DISCUSSION

The cement implant restoration connection that would at one time be supragingivally located has, increasingly, become subgingivally located due to society's more exacting esthetic demands, leading to concern about the relationship between restoration and supporting tissue, because a failure in the adaptation of these connections inevitably leads to the formation of spaces (gaps) that are niches for colonies of bacterial plaque, which is the primary cause of periodontal disease and periimplantitis. It is also important to mention that the mechanical spaces (gaps) may contribute to the fatigue, fracture, or loss of components and increasing corrosion rates.⁵

In this study, crowns cemented on metal abutments were compared. Metal–ceramic crowns exhibited better marginal fits than In-Ceram crowns. These data contradict other research, which showed that the marginal discrepancies of ceramic crowns (Empress 2) were significantly lower than those of metal–ceramic crowns.¹ However, the study in question used extracted human teeth (third molars) and tooth preparation as the abutments for crown cementation. In contrast, the metal abutments used in the present study were obtained from standardized prosthetic wax-ups, which may have had an influence on the results.

In a comparison of the marginal adaptation of implant-supported cemented crowns, before and after cementation, the data were similar to those of other studies,⁵⁻⁹ which reported that the marginal discrepancy prior to and after crown cementation on implants increased significantly.^{10,11} However, different results were found in another study,⁵ which stated that the luting procedure did not significantly affect the marginal adaptation of posterior fixed dental prostheses fabricated using three different ceramic systems, Lava All-Ceramic System, Procera Bridge Zirconia, and VITA In-Ceram 2000 YZ and metal-ceramic manufactured using the conventional lost-wax technique.^{5,12} Nevertheless, an internal relief of 50 µm made on the abutments before specimen preparation may have had an influence on the marginal fit of the restoration. Moreover, the use of CAD/CAM technology, in which the infrastructure design of crowns is computerized and which precisely defines the internal space between the abutment and crown surfaces, may have influenced the marginal adaptation, which was not the case in this study.^{5,13-15}

CONCLUSION

Based on the observations described, the following conclusions can be drawn:

- Metal-ceramic crowns exhibited better marginal adaptation than In-Ceram crowns, irrespective of cementing procedure.
- The cementing procedure has a significant influence on the marginal adaptation of cemented crowns, irrespective of crown type.

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