# Marginal and Internal Discrepancies of Posterior Zirconia-Based Crowns Fabricated with Three Different CAD/CAM Systems Versus Metal-Ceramic

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***Purpose:*** The aim of this study was to analyze the marginal and internal fit of metal-ceramic and zirconia-based crowns. ***Materials and Methods:*** Forty standardized steel specimens were prepared to receive posterior crowns and randomly divided into four groups (n = 10): *(1)* metal-ceramic, *(2)* NobelProcera Zirconia, *(3)* Lava Zirconia, and *(4)* VITA In-Ceram YZ. All crowns were cemented with glass-ionomer agent and sectioned buccolingually. A scanning electron microscope was used for measurements. Kruskal-Wallis and Wilcoxon signed rank test ($\alpha = .05$) statistical analyses were conducted. ***Results:*** Significant differences ($P < .0001$) in marginal discrepancies were observed between metal-ceramic and zirconia groups. No differences were found for the axial wall fit ($P = .057$). Significant differences were shown among the groups in discrepancies at the occlusal cusp ($P = .0012$) and at the fossa ($P = .0062$). No differences were observed between surfaces. ***Conclusions:*** All zirconia groups showed better values of marginal discrepancies than the metal-ceramic group. Procera Zirconia showed the lowest gaps. *Int J Prosthodont 2015;28:509–511. doi: 10.11607/ijp.4359*

Patients' growing demands regarding the esthetics of dental restorations and their concomitant rejection of the use of metal structures has driven the popularity of all-ceramic systems. During the last decade, research on dental ceramics has focused on zirconia due to its high strength and on computer-aided design/computer-assisted manufacture (CAD/CAM) technology to achieve an optimal fit.[1,2]

In addition to fracture strength and esthetics, marginal and internal adaptation is one of the most important conditions for the long-term success of restorations, since gaps induce adverse effects that ultimately cause treatment failure.[1,2] To date, little in vitro research has been carried out on the internal adaptation of zirconia restorations.

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The purpose of the present study was to evaluate the marginal and internal gaps in zirconia and metal-ceramic crowns and analyze buccal and lingual surfaces. The null hypothesis was that there would be no difference in marginal and internal adaptation between the zirconia and the metal-ceramic restorations and surfaces.

## Materials and Methods

Forty steel specimens were machined to simulate a maxillary first premolar prepared for a full-coverage restoration with a 1-mm-wide circumferential chamfer finish line and axial walls tapered at 6 degrees. Specimens were randomly divided into four groups (n = 10): *(1)* metal-ceramic (control) (Kera C, Eisenbacher Dentalwaren), *(2)* NobelProcera Zirconia (Nobel Biocare), *(3)* Lava Zirconia (3M ESPE), and *(4)* VITA In-Ceram YZ (VITA Zahnfabrik). The zirconia crowns were prepared according to the manufacturer´s specifications, and the metal-ceramic crowns were fabricated following the conventional lost-wax technique. All crowns were cemented onto the master dies with glass-ionomer cement (Ketac Cem EasyMix, 3M ESPE) and held in place with a dynamometric key (USAG 820/70, Utensilerie) applying a load of 10 N for 10 minutes. The samples were embedded in a thermal polymerization resin (TAAB, TAAB Laboratories)

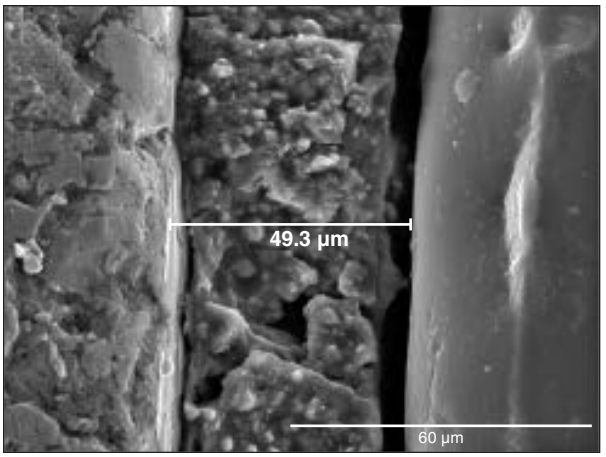


**Fig 1** SEM image showing the axial gap of a Lava specimen (magnification ×1000).

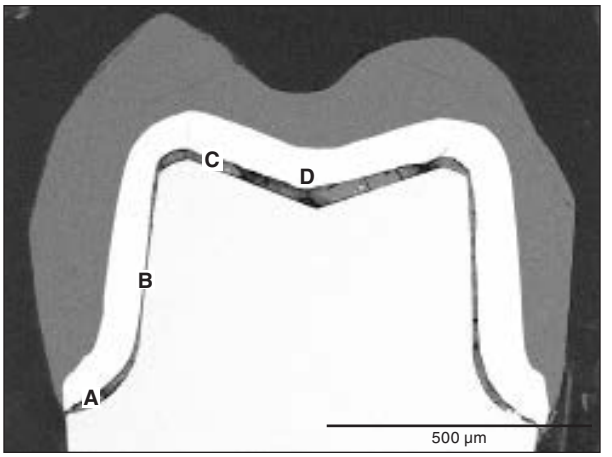


**Fig 2** Measurement locations (magnification ×10): **(a)** internal marginal gap, **(b)** internal axial gap, **(c)** occlusal gap at the cusp, and **(d)** occlusal gap at the fossa.

**Table 1** Mean and SD Values (µm) of Marginal, Axial, and Occlusal Discrepancies in Each Group for Buccal and Lingual Surfaces

| | Marginal | | Axial | | Occlusal cusp | | Occlusal fossa | |
|---|---|---|---|---|---|---|---|---|
| Group | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Metal-ceramic | 101.5 | 35.05 | 44.13 | 22.00 | 103.6 | 24.73 | 130.9 | 38.95 |
| Lava | 49.48 | 10.91 | 55.08 | 13.45 | 144.9 | 22.60 | 147.7 | 25.12 |
| Procera | 41.09 | 7.54 | 55.12 | 21.59 | 80.96 | 43.49 | 74.13 | 41.18 |
| YZ | 65.63 | 34.59 | 68.68 | 18.45 | 117.8 | 46.16 | 136.8 | 26.65 |

and sectioned buccolingually with a cutting machine (Labcut 150, Benetec).

The internal vertical marginal gap, axial gap, and occlusal gap at the cusp and at the fossa were measured at the same points on the buccal and lingual surfaces of the restorations under a scanning electron microscope (SEM) (JSM-6400, JEOL) with a magnification of × 1000 (Figs 1 and 2). Thirty measurements were recorded for each variable and surface.

Statistical analyses were performed with the Kruskal-Wallis test, the multicomparison post hoc analysis among the groups, and the Wilcoxon signed rank test to compare the buccal and lingual measurements. Statistical significance was set at $P < .05$. The SAS 9.1 statistical software (SAS Institute) was used for all calculations.

## Results

Table 1 shows the means and SDs for the groups and the variables analyzed. The internal marginal gaps for the experimental groups were within the clinically acceptable range. Statistically significant differences ($P = .0001$) were shown between the metal-ceramic and the zirconia groups. In the axial wall, no significant variations were shown among the groups ($P = .057$). The internal occlusal gap at the fossa exhibited significant differences ($P = .0012$) between the Procera group and the other groups. Significant differences were also found for the occlusal gap at the cusp ($P = .0062$) between Lava and the metal-ceramic group and between Lava and the Procera group.

No differences were observed between buccal and lingual values for the internal marginal discrepancy ($P = .55$), axial wall gap ($P = .59$), or occlusal gap at the cusp ($P = .96$).

No differences were observed among the groups for undercontoured ($P = .189$) or overcontoured ($P = .21$) surfaces.

## Discussion

To date, no consensus has been reached on the clinically acceptable precision of fit, and no general guideline exists on how to perform gap measurements. Previous studies report that discrepancies below 100 µm seem to be clinically acceptable.[1–5] In the present study the gap values obtained for all groups were clinically acceptable except for the occlusal surface. The marginal and axial gap values were almost the same as those of the designed cement space (50 µm), but at the occlusal surface the discrepancies were markedly larger and could be due to shrinkage of zirconia blanks subjected to post-machining sintering.[2]

The zirconia groups demonstrated differences with respect to marginal fit of the metal-ceramic group, confirming that the CAD/CAM technique provided more precision than the conventional metal-ceramic technique. The lowest discrepancies obtained in the Procera group could be explained by the different digitization system used.[3]

No differences were observed between surfaces for the zirconia systems. This could be explained by the precision of the digitization system and the mechanized technique used.[3]

Previous studies were taken into consideration regarding the minimum number of measurements needed to ensure relevant results,[4] and all measurements were performed by the same operator. However, there were some limitations in the present study. The crowns were fabricated under standardized and optimal conditions, but, in clinical practice, the fit is influenced by tooth preparation and impression or cementation technique. In addition, the intraoral environment was not simulated.[2] Another limitation was that the study used the cross-sectional technique to obtain the data resulting in the destruction of the restoration,[1] and the measured areas might not represent the precision of fit of the whole specimen.[5]

## Conclusions

The recorded values for the zirconia groups showed better values of marginal adaptation than the metal-ceramic group. No differences were shown for surfaces.

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*Literature Abstract*

**Generalized aggressive periodontitis as a risk factor for dental implant failure: A systematic review and meta-analysis**

This study investigated survival rates (SRs) and marginal bone loss (MBL) in patients with generalized aggressive periodontitis (GAgP) compared to patients with chronic periodontitis (CP) and healthy patients (HPs). One reviewer conducted an electronic literature search from 2000 to 2013. Articles were selected based on the following inclusion criteria: prospective or retrospective human clinical trials whereby the SRs and MBL of implant-supported prostheses in patients with a history of GAgP were compared with patients with a history of CP or HPs. Six nonrandomized prospective clinical trials met this criteria. The SRs ranged from 83.3% to 100% for the GAgP group, 96.4% to 100% for the CP group, and 96.6% to 100% for the HP group. An overall risk ratio of 0.96 (95% CI = 0.91 to 1.01, P = 0.14) was found between GAgP and HP, and a risk ratio of 0.94 (95% CI = 0.87 to 1.01, *P* = 0.09) was found between GAgP and CP. When failure rate was examined, an overall risk ratio of 4.00 and 3.97 was found between GAgP and HPs, and GAgP and CP, respectively. The MBL weighted mean difference was 0.15 mm (95% CI = 0.04 to 0.26) for HP versus CP, –0.28 mm (95% CI = –0.36 to –0.19) for HP versus GAgP, and –0.43mm (95% CI = –0.53 to –0.33) for CP versus GAgP. The authors conclude that implant treatment in patients with a history of GAgP might be a viable option, with similar survival rates found in HPs and patients with CP. However, the failure rates were higher compared with HPs and CP. Hence, a comprehensive maintenance program for patients with a history of GAgP is recommended in order to identify early peri-implant bone loss.

**Monje A, Alcoforado G, Padial-Molina M, Suarez F, Lin GH, Wang HL.** *J Periodontol* 2014;85:1398–1407. **References:** 50. **Reprints:** Dr Alberto Monje, Juan Miró s/n, local 16-17, 06010 Badajoz, Spain. Fax: 0034-924-260-773. Email: amonjec@umich.com—*Teo Juin Wei, Singapore*