Marginal and Internal Fit of Conventional Metal-Ceramic and Lithium Disilicate CAD/CAM Crowns

Se-Jin Nam, DDS, MSD[a]/Mi-Jung Yoon, DDS, MSD, PhD[b]/Won-Hee Kim, DDS[c]/
Gil-Ju Ryu, DDS[c]/Min-Ki Bang, DDS[c]/Jung-Bo Huh, DDS, MSD, PhD[b]

This study aimed to evaluate and compare the marginal and internal gap widths of lithium disilicate computer-aided design / computer-assisted manufacture (LDC) crowns and conventionally produced porcelain-fused-to-metal (PFM) crowns. A convenience sample of 21 patients treated with a single restoration was selected. PFM and LDC crowns were fabricated for each selected abutment tooth, following traditional crown preparation. Silicone replicas were produced, and internal gaps and marginal gaps were measured. Internal gaps were significantly larger for the axial and occlusal surfaces of LDC crowns than for those of PFM crowns ($P < .001$). Marginal gaps were not significantly different ($P > .05$). Both LDC crowns and PFM crowns showed clinically acceptable marginal fit. *Int J Prosthodont 2015;28:519–521. doi: 10.11607/ijp.4089*

Computer-aided design/computed-assisted manufacture (CAD/CAM) systems are now extensively used in clinical dentistry. Numerous in vitro studies have been conducted to evaluate the fit of CAD/CAM restorations and compare CAD/CAM with traditional casting protocols.[1,2] Relatively few studies have compared metal-ceramic crowns and CAD/CAM restorations in patients. In this preliminary multicenter report, internal and marginal gap widths of lithium disilicate CAD/CAM (LDC) crowns and conventionally produced porcelain-fused-to-metal (PFM) crowns are compared.

Materials and Methods

Three dental clinics participated in this study. A convenience sample of 21 patients (9 women, mean age: 37.9 years; 12 men, mean age: 42.8 years) needing a single restoration on premolars or canines agreed to participate and were treated by a board-certified prosthodontist. The periodontal conditions of abutment teeth were healthy, and the selected teeth had already been treated endodontically and were thus fit for tooth preparation for esthetic purposes. An impression was made using silicone material (Delikit, HappiDen), and a model was constructed. Dies were covered with a 30-µm thick die spacer (YETI, YETI Dental), leaving a 1-mm marginal area free of spacer. PFM crowns were produced in the conventional manner. For LDC crowns, optical impressions were obtained using the CEREC Bluecam (Sirona Dental), and crowns were designed after setting the luting space to 30 µm. All-ceramic crowns were produced by milling a ceramic block (IPS e.max, Ivoclar Vivadent). Crown proximal contact was adjusted, but the inner surface was not. In each crown, two silicone replicas were produced for checking the gaps in the mesiodistal and buccolingual directions; each replica was sectioned in a buccolingual and in a mesiodistal direction in the center of the replica (Fig 1).[3] Ten reference points per tooth were set, 5 points in each direction, to measure gaps (Fig 2). Mean gap widths at the center of each replica were compared using one-way analysis of variance with Tukey multiple comparison tests at a significance level of .05. The independent *t* test was performed at a significance level of $\alpha = .05$ to determine differences in gap width at the reference points between the LDC crowns and PFM crowns.

Results

No statistically significant difference was found in gap widths using the central reference points of LDCs ($P > .05$; Table 1) and PFM crowns ($P > .05$; Table 2).

[a]*Resident, Department of Prosthodontics, School of Dentistry, Pusan National University, Yangsan, Gyeongnam, Korea.*
[b]*Associate Professor, Department of Prosthodontics, School of Dentistry, Pusan National University, Yangsan, Gyeongnam, Korea.*
[c]*Clinician, Goodwill Dental Hospital, Saha-gu, Pusan, Korea.*

Correspondence to: *Dr Jung-Bo Huh, Department of Prosthodontics, School of Dentistry, Pusan National University, Yangsan, Gyeongnam 626-770, Korea. Fax: +82-55-360-5134. Email: neoplasia96@daum.net*

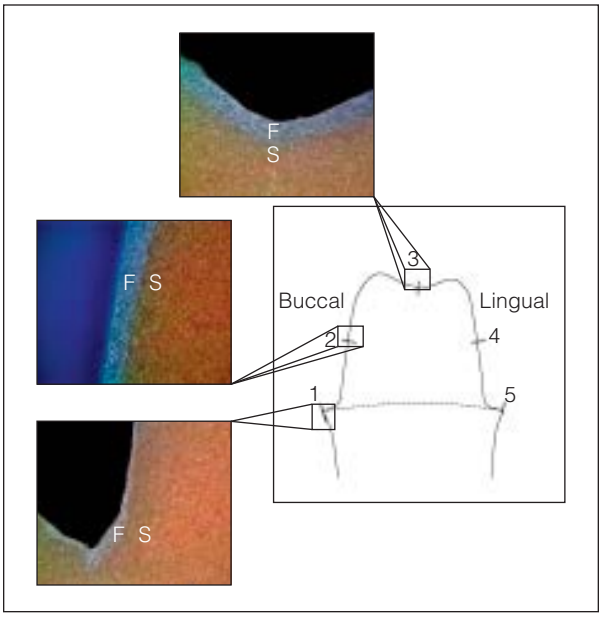

Fig 1 *(left)* Images captured after sectioning in a buccolingual direction using the replica technique (magnification ×100). F = silicone disclosing media (Fit-Checker, GC); S = silicone regular body.

Fig 2 *(below)* Reference points for measuring thicknesses of silicone replicas. **(a)** Buccolingual direction. **(b)** Mesiodistal direction.

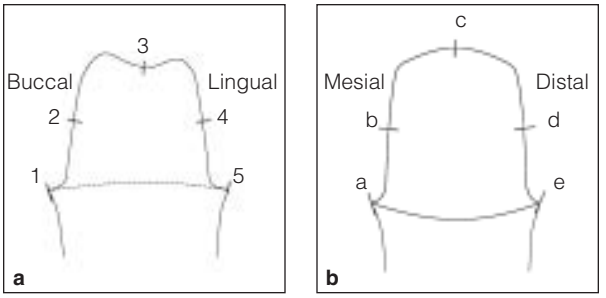

Table 1 Means and SDs of Gap Width at Each Center for the LDC Crowns (μm)

Center	Mean	SD	*F*	*P*
1	180.96	136.93		
2	203.32	132.44	1.826	.163
3	171.57	115.33		

Table 2 Means and SDs of Gap Width of Each Center in PFM Crowns (μm)

Center	Mean	SD	*F*	*P*
1	116.22	98.84		
2	122.48	78.23	.818	.442
3	108.34	68.86		

Table 3 Means and SDs of Gap Widths at Each Reference Point (μm)

Point	System	Mean	SD	*t*	*P*
1	LDC PFM	134.78 117.27	102.05 83.72	1.077	.283
2	LDC PFM	138.58 83.67	55.99 48.75	6.009	.000
3	LDC PFM	388.57 184.52	95.88 99.32	12.008	.000
4	LDC PFM	145.01 84.97	76.36 49.10	5.373	.000
5	LDC PFM	123.59 109.52	58.98 77.98	1.169	.244
a	LDC PFM	125.57 124.37	66.18 97.72	66.178	.934
b	LDC PFM	121.61 74.88	40.03 50.50	5.891	.000
c	LDC PFM	370.82 193.63	93.74 98.99	10.559	.000
d	LDC PFM	141.79 79.10	47.49 46.08	7.696	.000
e	LDC PFM	142.54 144.48	74.89 115.48	-0.114	.909

The means and standard deviations of gap widths at each reference point are summarized in Table 3. Statistical analysis showed significant differences at reference points 2, 3, and 4 in the buccolingual direction ($P < .001$; Fig 3) and at reference points b, c, and d in the mesiodistal direction ($P < .001$; Fig 4). As for marginal gaps, no significant difference was noted ($P > .05$, Table 3). The internal gap was significantly larger at axial and occlusal surfaces of LDC crowns ($P < .001$; Table 3).

Discussion

Several in vitro studies report on the variables that can affect marginal and internal fit.[4,5] Diverse considerations are more easily controlled in vitro, as clinical studies involve numerous uncontrollable factors. The present study focused on aspects of clinical effectiveness related to marginal and internal gap widths in the traditional and CAD/CAM production methods. Most measurement values obtained in the present study are greater (much greater at some points) than those reported in similar studies, since the clinical nature

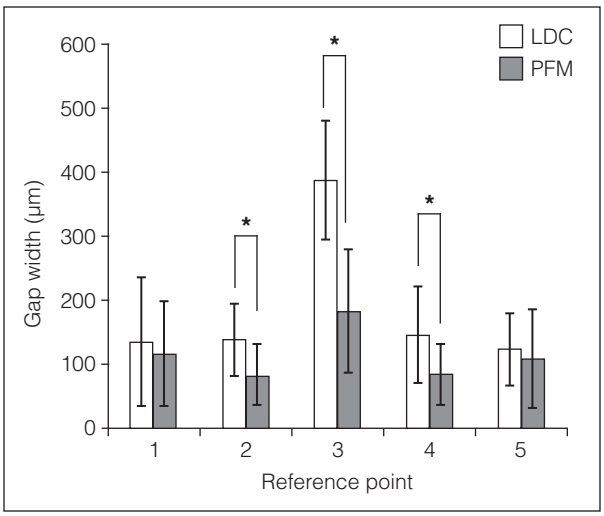

Fig 3 Means and SDs of gap widths at each reference point in the buccolingual direction.
*$P < .001$.

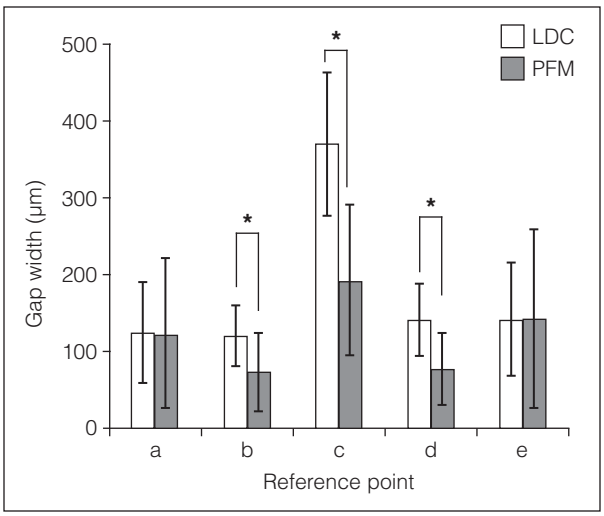

Fig 4 Means and SDs of gap widths at each reference point in the mesiodistal direction.
*$P < .001$.

of the present study could not be easily manipulated. The use of powder may also have affected the results, and the precision of the intraoral scanner used in this study was slightly less effective than the Cerec InLab scanner used in previous studies. It is also possible that gap widths of the PFM and LDC crowns measured high because of the finger pressure and the consistency of the silicone disclosing media. Thus, we suggest the focus should be on relative rather than absolute values.

Conclusion

In this preliminary report, LDC crowns were shown to have generally higher internal gap measurements than PFM crowns. However, the difference in the marginal gap measurements between the two groups was not statistically significant. The relevance of these observations in the context of long-term clinical outcomes still needs to be studied and evaluated.

Acknowledgments

This research was supported financially by the Ministry of Trade, Industry, and Energy and by a Promoting Regional Specialized Industry grant (R0002743) from the Korean Institute for the Advancement of Trade and by a clinical research grant from Pusan National University Dental Hospital. The authors reported no conflicts of interest related to this study.

References

1. Kim SJ, Jo KH, Lee KB. A comparison of the fidelity of various zirconia-based all-ceramic crowns fabricated with CAD/CAM systems. J Korean Acad Prosthodont 2008;47:148–155.
2. Reich S, Wichmann M, Nkenke E, Proeschel P. Clinical fit of all-ceramic three-unit fixed partial dentures, generated with three different CAD/CAM systems. Eur J Oral Sci 2005;113:174–179.
3. Molin M, Karlsson S. The fit of gold inlays and three ceramic inlay systems: A clinical and in vitro study. Acta Odontol Scand 1993;51:201–206.
4. Rinke S, Fornefett D, Gersdorff N, Lange K, Roediger M. Multifactorial analysis of the impact of different manufacturing processes on the marginal fit of zirconia copings. Dent Mater J 2012;31:601–609.
5. Pak HS, Han JS, Lee JB, Kim SH, Yang JH. Influence of porcelain veneering on the marginal fit of Digident and Lava CAD/CAM zirconia ceramin crowns. J Adv Prosthodont 2010;2:33–38.