Evaluation of the Marginal Fit of a CAD/CAM Zirconia-Based Ceramic Crown System

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INTRODUCTION

Ceramic crowns have become widely used for a variety of reasons, including good esthetics. Zirconia (Zi)-based prostheses have emerged as a viable alternative to metal-ceramic and other traditional ceramic-based options for indirect restorations. In addition, CAD/CAM fabrication has gained popularity over conventional methods.

Marginal fit is an important criterion of clinical acceptability and subsequent clinical success. The clinically acceptable limit for marginal discrepancy of crowns is considered to be up to 120 µm. Several studies have evaluated the marginal accuracy of CAD/CAM ceramic crowns and found mixed results. Apart from marginal gap and overhang, the influence of margin geometric configuration also warrants examination.

This study evaluated the marginal fit of full-coverage CAD/CAM Zi crowns compared to monolithic lithium disilicate (LDS) crowns (as a control), and secondly the effect of margin design, with respect to two finish line designs (shoulder and chamfer), on marginal fit.

METHODS & MATERIAL

Twenty stone dies, acquired from each of two master metal dies with two different finish lines (shoulder and chamfer), were scanned to produce digital models. On the resultant 40 dies, ceramic crowns (KaVo ZS-Ronde Zi and IPS e.max CAD LDS) were designed and milled: 10 Zi-shoulder, 10 Zi-chamfer, 10 LDS-shoulder, 10 LDS-chamfer. Marginal gap and overhang were evaluated at six designated margin locations (Fig. 1). Overhangs were defined as being horizontally over- or under-extended (Fig. 2).

Data were obtained and the influence of material and finish line on the marginal fit of crowns was assessed using two-way ANOVA and Bonferroni multiple comparison test (α = .05).

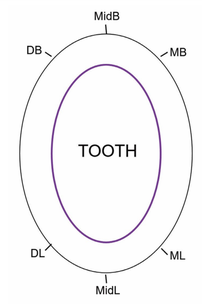

Fig 1. Marginal fit evaluation locations around the circumference of the tooth. ML = mesiolingual line angle; MidL = midlingual; DL = distolingual line angle; DB = distobuccal line angle; MidB = midbuccal; MB = midbuccal line angle.

RESULTS

Mean marginal gaps and overhangs for Zi crowns were 30 ± 14 µm and 79 ± 27 µm for shoulder, and 68 ± 34 µm and 104 ± 34 µm for chamfer, respectively. Corresponding values for LDS crowns were 57 ± 22 µm and 74 ± 29 µm for shoulder, and 62 ± 12 µm and 59 ± 27 µm for chamfer (Table 1).

Differences in marginal gap between the two materials were not significant ($P > .05$), but the finish line effect and the interaction were significant ($P < .05$) (Table 2).

With regard to marginal overhang, significant differences were found between Zi and LDS crowns ($P < .05$), although the finish line geometries did not show any significant differences ($P > .05$) (Table 3).

LDS crowns showed no differences between shoulder and chamfer margins for both gap and overhang ($P > .05$), whereas significant differences were found in marginal gap between Zi shoulder and chamfer margins ($P < .005$)

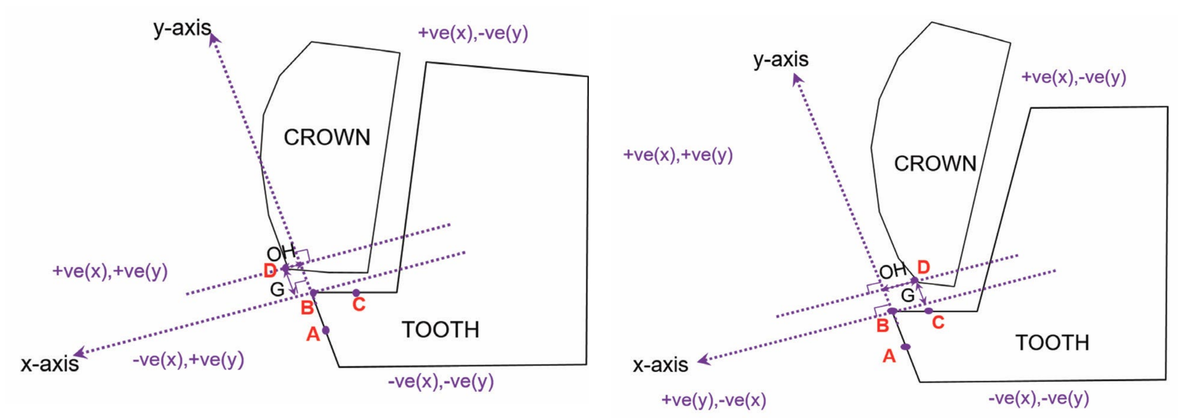

Fig. 2. A. Horizontally over-extended crown margin; B. Horizontally under-extended crown margin (G - marginal gap; OH - marginal overhang; Point A - point below the tooth preparation margin on the topmost edge of the meniscus of the indentation; Point B - point on the outermost edge of the tooth preparation margin; Point C - the last distinct point seen on the preparation finish line; and Point D - point on the outermost edge of the crown margin; +ve[x] – over-extension; -ve[x] – under-extension; +ve[y] - positive marginal gap; -ve[y] - negative marginal gap [not possible])

Material	Gap (µm)		Overhang (µm)	
	Shoulder	Chamfer	Shoulder	Chamfer
Zirconia	29.88 (13.75)	68.36 (24.02)	78.78 (27.43)	104.01 (34.22)
Lithium disilicate	57.46 (21.64)	61.73 (11.78)	73.65 (29.33)	59.48 (27.65)

Table 1. Mean (SD) of marginal gap and overhang of Zi and lithium disilicate crowns, by margin design (µm) (n=10)

Variables of interest	df	Sum of Squares	Mean Square	F	Sig. (P)
Material Zi LDS	1097.256	1	1097.256	2.215	.145
Finish Line Shoulder Chamfer	4568.906	1	4568.906	9.225	.004
Material * Finish Line	2926.951	1	2926.951	5.910	.020

Table 2. Two-way ANOVA for marginal gap

Variables of interest	Df	Sum of Squares	Mean Square	F	Sig. (P)
Material Zi LDS	6162.434	1	6162.434	6.945	.012
Finish Line Shoulder Chamfer	307.165	1	307.165	.346	.560
Material * Finish Line	3884.269	1	3884.269	4.378	.044

Table 3. Two-way ANOVA for marginal overhang

CONCLUSION

Within the present limitations, it can be concluded that:

- no significant difference exists in the marginal gap of Zi-based compared to LDS crowns ($P > .05$).
- shoulder margin of Zi-based crowns has significantly better mean marginal gap than the chamfer margin ($P < .05$).
- mean marginal gaps of Zi-based and LDS crowns are within the range of those reported in recent reviews.

The study was supported by Kuwait University research grant #DR03/16, and is published in Int J Prosthodont. 2022;35(3):319–329. doi: 10.11607/ijp.6654. Epub 2021 Feb 19.PMID: 33616567.