Clinical Outcome of Metal-Ceramic Crowns Fabricated with Laser-Sintering Technology

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This study evaluated the clinical outcome of posterior single-unit metal-ceramic crowns fabricated using computer-aided design/computer-assisted manufacture laser-sintering technology. Sixty restorations were placed in 39 patients and cemented with glass-ionomer cement. Follow-ups were performed annually. During a mean observation period of 47 months, one restoration was regarded a dropout, one crown failed (biologic failure), and one debonded. One abutment tooth had to be treated endodontically, and three teeth were treated because of caries. No further technical complications, eg, veneering ceramic chipping, occurred during the observation period. The results suggest that the clinical outcome of posterior single-unit metal-ceramic crowns fabricated using laser-sintering technology is promising. *Int J Prosthodont 2011;24:46–48.*

Computer-aided design/computer-assisted manufacture (CAD/CAM) milling techniques are commonly used to produce all-ceramic restorations. Because of the high loss of material, noble metal alloys are not used for these technologies. Milling base metal alloys results in a high loss of time and rapid wear of the milling tools. The aim of this in vivo study was to evaluate the clinical outcome of posterior single-unit metal-ceramic crowns fabricated with a new CAD/CAM laser-sintering technology (Bego Medical). This automated technology reduces labor costs in comparison to conventional casting techniques. Especially in industrial countries with higher labor costs, the laser-sintering technology will be beneficial economically.

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Materials and Methods

In total, 60 restorations were placed in 39 patients (23 women, 16 men; mean age: 52.5 years), restoring 16 premolars and 44 molars, between January 2004 and July 2006. A maximum of 2 crowns fabricated in the same alloy were placed in any patient. The teeth were prepared as follows: a circumferential chamfer finish line design, an occlusal reduction minimum of 1.5 mm, a circumferential reduction minimum of 0.8 mm, a total convergence angle of 6 degrees, and an abutment height minimum of 3 mm (Fig 1).

After tooth preparation, impression taking (Permadyne, 3M ESPE), and model casting (die stone type 4, gypsum; Fujirock, GC), each preparation was contactless scanned using strip light projection. The digital construction of the metal copings was completed using computer software (Softshape, Bego Medical). Then, a high-energy focused laser beam directly fused a localized region of a thin layer of a metal powder to build up the restoration gradually. A precious alloy (gold-platinum; BioPontoStar+, Bego Medical) and a base metal alloy (cobalt-chromium; Wirobond C+, Bego Medical) were used for 29 and 31 restorations, respectively.

The thickness of the metal copings was a minimum 0.35 mm for the base metal alloy and 0.5 mm for the noble alloy (Fig 2). The thickness of the veneered restoration was a minimum 1.5 mm occlusally and 0.8 mm cervically. After firing the veneering ceramic (IPS d.Sign, Ivoclar Vivadent), the metal-ceramic crowns were airborne particle–abraded (50 μm aluminum

Fig 1 Prepared abutment teeth before placement of the restorations.

Fig 2 **(a)** Occlusal and **(b)** inner surfaces of a metal coping fabricated using laser-sintering technology.

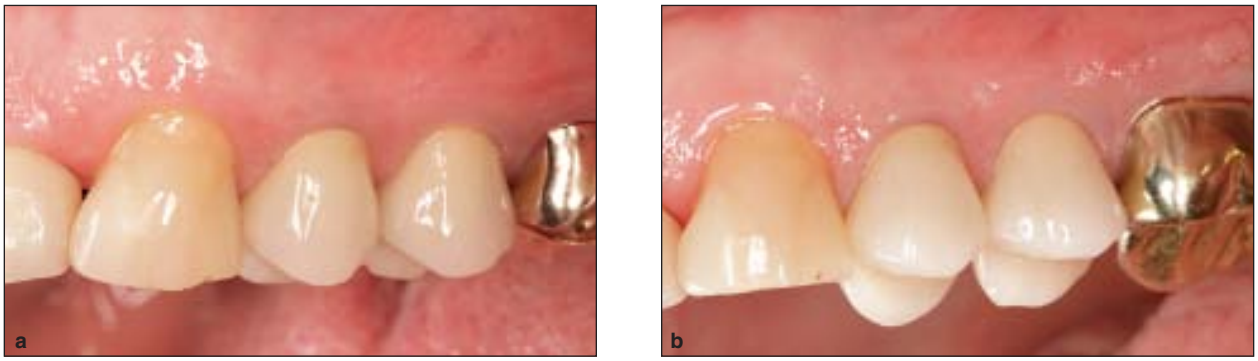

Fig 3 **(a)** Baseline and **(b)** 48-month follow-up clinical photographs for two crowns in the maxillary left molar region.

oxide, 2.5 bars) and cemented with glass-ionomer cement (Ketac Cem, 3M ESPE). Patients were recalled after 6 to 12 months and annually thereafter (Fig 3). Failure rates regarding loss of the restoration and biologic or technical complications were calculated according to Kaplan-Meier analysis.[1]

Results

During the mean observation period of 47 months (minimum: 19 months, maximum: 62 months), one restoration was regarded as a dropout because the patient did not attend the recall program for more than 24 months. One crown failed as a result of extraction after endodontic problems, and one debonded but was recemented immediately. Three teeth were treated because of caries at the margin of the restoration, and one abutment tooth had to be treated endodontically (Table 1). However, the latter complications did not affect the clinical function of the involved crowns. No further technical complications, eg, veneering ceramic chipping, occurred throughout the observation period. The cumulative survival rate according to Kaplan-Meier analysis after 47 months was 98.3% (Fig 4).

Table 1 Results of the Clinical Outcome

Complication	No. of restorations	Rate
Dropout (> 24 months without recall)	1	1.7%
Failure (extraction after endodontic problems)	1	1.7%
Caries at the margin	3	5.2%
Endodontic treatment	1	1.7%
Debonding	1	1.7%

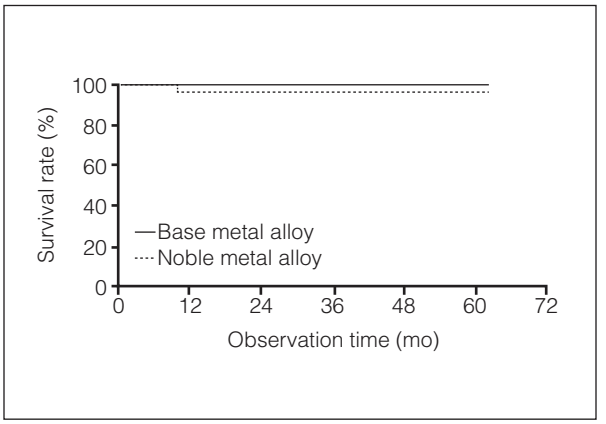

Fig 4 Kaplan-Meier curve demonstrating the cumulative survival rate for single-unit posterior metal-ceramic crowns made from a base metal and a precious alloy. The difference in failures between groups was not statistically significant ($P = .309$, log-rank test).

Discussion

The cumulative failure rate of the crowns after 47 months was 1.7%, which is comparable to that found for cast metal-ceramic crowns after 5 years in a recent meta-analysis (range: 2.5% to 7.6%).[2]

The rate of biologic complications such as caries at the margin of the crowns was 5.2% in this study. Again, this was comparable to that for cast metal-ceramic crowns after 5 years, as reported in a meta-analysis (range: 0.4% to 21.2%).[2] As demonstrated in a previous study, the marginal accuracy of the placed crowns ranged from 74 to 99 μm for both alloys.[3] Therefore, the marginal fit must be considered comparable to conventional production procedures.[4] Therefore, it can be assumed that insufficient marginal fit of the restorations was not responsible for the occurrence of caries, but rather hygienic deficiencies of the patient.

No technical complications such as ceramic chipping occurred during the observation period. In the meta-analysis on complication rates of conventional cast metal-ceramic reconstructions, a mean rate of 5.7% for veneering ceramic chippings was found.[2] This favorable result in the present study might be related to the anatomical preparation of the abutment teeth, the homogenous dimensions of the veneering ceramic, and an adequate ceramic bonding to the laser-sintered copings.[5]

Conclusion

The outcomes for posterior single-unit metal-ceramic crowns fabricated using laser-sintering technology are promising over the first 47 months of clinical observation. Over this period, the outcomes are comparable to that for conventionally fabricated metal-ceramic crowns.

Acknowledgment

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