Internal and Marginal Adaptation of Pressable and Computer-Aided Design/Computer-Assisted Manufacture Onlay Restorations

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The aim of this research was to evaluate internal and marginal adaptation of lithium disilicate partial crowns fabricated using IPS e.max Press and IPS e.max CAD systems. Forty maxillary first molars were divided into two groups. The margins were located above the cementoenamel junction mesially and below it distally. The adaptation of the restoration was evaluated by means of the silicone replica technique. The lowest marginal discrepancy was measured between the preparation margin on the enamel and the IPS e.max Press specimens; the highest discrepancy was observed on the occlusal surface of the IPS e.max CAD specimens. Both systems tested demonstrated acceptable marginal discrepancies in vitro. *Int J Prosthodont 2012;25:262–264.*

The increased use of ceramic inlays luted with composite resin cements and the introduction of computer-aided design/computer-assisted manufacturing (CAD/CAM) technology as a fabrication technique have intensified the debate over the internal and marginal fit of dental restorations. Fabricating dental restorations by use of CAD/CAM provides several advantages compared to the lost-wax/heat pressing technique.[1–4]

The null hypothesis of this study was that there would be a difference in marginal fit of pressed and CAD/CAM-fabricated partial-coverage restorations when tested under standardized conditions and that the location of the restoration margins would influence marginal discrepancies. Thus, the aim of this study was to evaluate the effect of onlay restorations fabricated with lithium disilicate using pressable ingots and CAD/CAM technology on marginal and internal adaptation.

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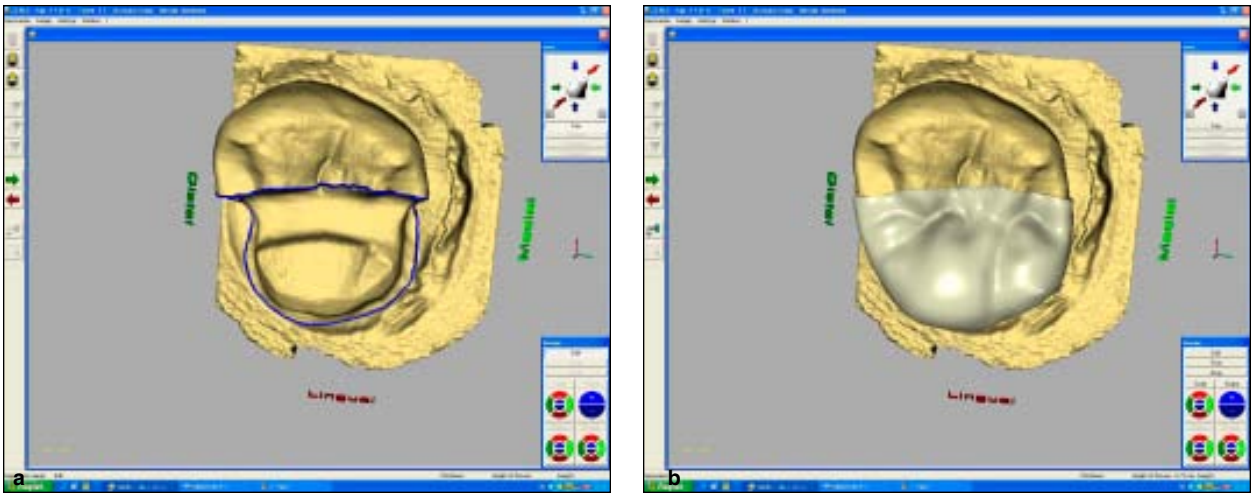
Materials and Methods

Forty intact, noncarious, unrestored human maxillary first molars extracted for periodontal reasons were selected for this study. The teeth were divided into two groups of 20 specimens each. The preparation design was based on a mesio-occlusal-distal-lingual onlay cavity with a 3-mm-deep occlusal box, an isthmus width of 2 mm, and an overall preparation angle of 6 degrees toward the occlusal aspect. Furthermore, the occlusal surfaces of the lingual cusps were reduced by 2 mm according to the tooth anatomy. Proximal margins were located 1 to 2 mm above the cementoenamel junction mesially and 1 to 2 mm below it at distal aspects. Preparations were carried out with the handpiece stabilized in a dental surveyor (KaVo EWL, Type 990, KaVo).

Twenty onlay restorations were produced with pressable lithium disilicate glass-ceramic ingots (IPS e.max Press, Ivoclar Vivadent) according to the manufacturer's instructions, and 20 onlay restorations were produced with CAD/CAM technology using lithium disilicate ceramic blocks (IPS e.max CAD, Ivoclar Vivadent) (Figs 1a and 1b).

The internal fit and marginal adaptation of the onlay to the tooth cavity were evaluated by means of the silicone replica technique. Replicas were sectioned buccopalatally into two parts and mesiodistally into three parts, and fit was examined at 200× magnification using a light microscope (Leica Optik, Leica). In each sample, 40 measurements were evaluated, totaling 1,600 measurements (Fig 2).



Figs 1a and 1b **(a)** Fabrication and **(b)** completed design of the onlay restorations using CAD/CAM technology.

Fig 2 Mesiodistal and buccopalatal sections showing the locations of the measuring points. M = mesial; D = distal; B = buccal; P = palatal.

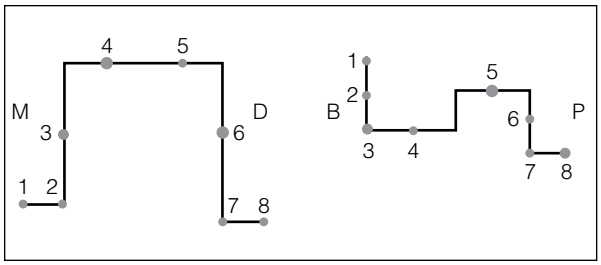


Table 1 Mean Values and Standard Deviations (μm) of Marginal and Internal Adaptation of the Two Systems

Surface	e.max CAD	e.max Press	Significance*
Marginal dentin	119.65 ± 27.80	119.28 ± 25.76	.966
Internal marginal dentin	152.83 ± 39.82	118.76 ± 37.88	.009
Axial	132.77 ± 31.32	96.53 ± 21.54	.001
Occlusal	196.49 ± 38.16	134.55 ± 39.27	.001
Internal marginal enamel	174.52 ± 36.56	119.74 ± 32.49	.001
Marginal enamel	112.14 ± 15.64	99.08 ± 16.34	.014

*$P < .05$.

Results

The mean values, standard deviations, and *P* values determined for the internal and marginal fit of the restorations are presented in Table 1. Marginal discrepancies of IPS e.max CAD restorations were significantly greater when compared to IPS e.max Press on enamel ($P = .01$), but the difference was not statistically significant on dentin. A significant difference in the internal fit was seen between IPS e.max Press and IPS e.max CAD at axial and occlusal surfaces ($P = .01$).

Discussion

High marginal accuracy and adequate internal adaptation are considered to be the major determining factors for the successful clinical performance of a restoration.[1–4] The preparations were performed according to preparation guidelines for onlay restorations mentioned in the literature.[1,3] A value of 120 μm was used as the clinically acceptable marginal gap.[1–4] It is well known that marginal discrepancy generally increases after cementation, which occurs clinically. Thus, in this study, to correctly determine marginal

discrepancy, evaluations were performed before cementation. The different results obtained in the studies may have been caused by the fact that the number and location of the measuring points varied and that different measuring techniques were used. The results of this study are in compliance with earlier studies.

In accordance with the null hypothesis, differences in marginal fit were recorded for ceramic partial restorations fabricated using different manufacturing techniques. IPS e.max CAD is a machinable lithium disilicate ceramic material that was developed to improve the strength of glass-ceramic materials. In this study, a significant difference ($P = .01$) in internal fit was seen between IPS e.max Press and IPS e.max CAD at axial and occlusal surfaces. This might have been a result of differences in composition and fabrication techniques of the materials, but both systems demonstrated acceptable marginal discrepancies in vitro.

Conclusions

Differences in marginal fit were recorded for ceramic partial restorations fabricated using different manufacturing techniques. Both systems demonstrated acceptable marginal discrepancies in vitro. Long-term follow-up studies are necessary to evaluate the clinical outcome of different fabrication techniques.

References

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Literature Abstract

Care and aftercare related to implant-retained dental crowns in the maxillary aesthetic region: A 5-year prospective randomized clinical trial

This prospective study investigated the surgical and prosthetic care and aftercare of patients treated with an implant-retained crown in the maxillary esthetic region after local bone augmentation. Ninety-three patients with a missing tooth in the anterior region of the maxilla were included based on the inclusion and exclusion criteria of the study. Patients were randomly placed into one of three local bone augmentation groups aimed at an equal distribution regarding variables that may interfere with the treatment outcome: group 1, chin bone; group 2, chin bone covered by a resorbable guided bone regeneration membrane (Bio-Gide); and group 3, Bio-Oss spongiosa granules covered with a Bio-Gide membrane. Three months after augmentation with chin bone (groups 1 and 2) or 6 months after augmentation with Bio-Oss (group 3), 4.1-mm-diameter implants (ITI Esthetic Plus) were placed. Implants were submerged and allowed to heal for 6 months. During the healing period, patients wore a provisional partial denture. After 6 months, a provisional crown was screwed onto the implant. One month later, the synOcta abutment was screwed onto the implant, and the definitive porcelain crown with zirconia core (Procera) was cemented onto the abutment. The char time for surgical and prosthetic care and aftercare was scored from the first visit until 5 years after the local bone augmentation. Five well-defined periods were analyzed: pretreatment, surgical care, prosthetic care, surgical aftercare, and prosthetic aftercare. The results showed that implant placement in the maxillary esthetic region augmented with any of the three local bone augmentation procedures was safe and reliable (5-year implant survival rate: 96.7%), surgical and prosthetic treatment made up three-quarters of the overall treatment time, need for care and aftercare was not dependent on the local bone augmentation procedure, and not much aftercare was needed except for periodic preventive routine inspections, routine oral hygiene care, and fabrication of a new crown in 12% of patients in 5 years.

Visser A, Raghoebar GM, Meijer HJ, Meijndert L, Vissink A. *Clin Implant Dent Relat Res* 2011;13:157–167. **References:** 42. **Reprints:** Dr Anita Visser, Department of Oral and Maxillofacial Surgery and Maxillofacial Prosthodontics, University Medical Center Groningen, PO Box 20.001, NL-9700 RB Groningen, The Netherlands. Email: a.visser@kchir.umcg.nl—*Simon Ng, Singapore*