A Preliminary Study on the Short-Term Efficacy of Chairside Computer-Aided Design/Computer-Assisted Manufacturing–Generated Posterior Lithium Disilicate Crowns

Sven Reich, Priv Doz, Dr Med Dent[a]/Sören Fischer, DDS[b]/Bernhard Sobotta, Dr Med Dent, MOM[c]/Horst-Uwe Klapper, Dr Med Dent[c]/Stephan Gozdowski, DDS[d]

The purpose of this preliminary study was to evaluate the clinical performance of chairside-generated crowns over a preliminary time period of 24 months. Forty-one posterior crowns made of a machinable lithium disilicate ceramic for full-contour crowns were inserted in 34 patients using a chairside computer-aided design/computer-assisted manufacturing technique. The crowns were evaluated at baseline and after 6, 12, and 24 months according to modified United States Public Health Service criteria. After 2 years, all reexamined crowns (n = 39) were in situ; one abutment exhibited secondary caries and two abutments received root canal treatment. Within the limited observation period, the crowns revealed clinically satisfying results. *Int J Prosthodont 2010;23:214–216.*

Lithium disilicate ceramics have been available on the market for single crowns and short-span fixed partial dentures (up to the second premolar) since 1998. Whereas former lithium disilicate ceramics could only be used as framework materials due to limited esthetics, the material IPS e.max CAD LT (low translucency; Ivoclar Vivadent) can be used for full-contour anterior and posterior crowns. Therefore, it is possible to use this material to provide a patient with an all-ceramic crown within a single appointment using a chairside computer-aided design/computer-assisted manufacturing (CAD/CAM) method. The machinable blocks are milled in a metasilicate state of bluish color. After try-in, the tooth-colored lithium disilicate structure is obtained by a crystallization firing at 840°C, which takes approximately 25 minutes.[1] After firing, the crowns have obtained a flexural strength of 360 MPa (± 60 MPa) and a fracture toughness between 2.0 and 2.5 MPa*$m^{0.5}$. The manufacturer recommends either adhesive luting or conventional cementation of the crowns. The aim of this prospective clinical trial was to evaluate the newly developed lithium disilicate ceramic for chairside application.

Materials and Methods

Forty-one IPS e.max CAD LT lithium disilicate posterior crowns (10 premolars, 31 molars) were inserted in 34 patients (13 men, 21 women) who showed an indication for a posterior crown restoration and had given written consent to take part in a clinical prospective study, which was approved by the ethics committee of the University of Leipzig, Leipzig, Germany (application no. 103-2006). At the beginning of the study, the mean age of the patients was 48 years (minimum: 26 years, maximum: 74 years, standard deviation: 13.5 years). Twenty teeth were successfully treated with root canal therapy; 20 teeth were vital. Seven of the 20 root canal–treated teeth were restored with adhesive composite buildups;

[a]*Senior Lecturer and Senior Physician, Department of Prosthodontics and Dental Materials, Medical Faculty, RWTH Aachen University, Aachen, Germany; Visiting Dentist, University of Leipzig, Leipzig, Germany.*
[b]*Private Practice, Leipzig, Germany.*
[c]*Researcher and Lecturer, Department of Prosthodontics and Material Sciences, University of Leipzig, Leipzig, Germany.*
[d]*Senior Physician and Lecturer, Department of Prosthodontics and Material Sciences, University of Leipzig, Leipzig, Germany.*

***Correspondence to:** Dr Sven Reich, Department of Prosthodontics and Dental Materials, Medical Faculty, RWTH Aachen University, Pauwelsstrasse 30, D-52074 Aachen, Germany. Email: sreich@ukaachen.de*

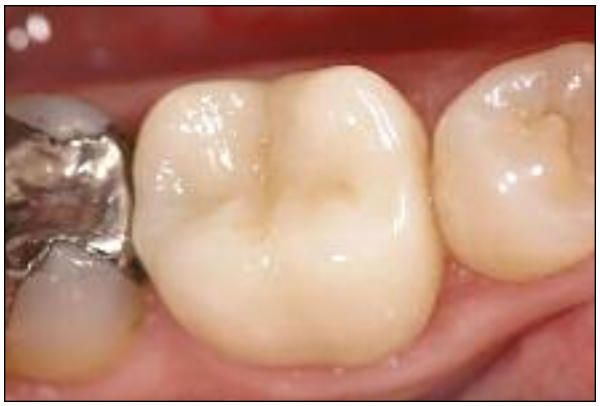

Fig 1 Occlusal view of a chairside-generated mandibular right first molar made of lithium disilicate ceramic after insertion.

Table 1 Modified USPHS Criteria[2]

Modified criteria	Description	Analogous USPHS criteria
Excellent (A1)	Perfect	Alfa (A)
Good (A2)	Slight deviations from ideal performance, correction possible without damage of tooth or restoration	Alfa (A)
Sufficient (B)	Few defects, correction impossible without damage of tooth or restoration; no negative effects expected	Bravo (B)
Insufficient (C)	Severe defects, prophylactic removal for prevention of severe failures	Charlie (C)
Poor (D)	Immediate replacement necessary (exception: endodontic treatment)	Delta (D)

USPHS = United States Public Health Service.

11 received both adhesive fiber posts and composite buildups. In 2 cases, the metal posts and the cores made of metal alloy were left. The antagonists of all crowns were either the natural dentition or exclusively tooth-supported restorations.

The restorations were fabricated chairside by four dentists using the Cerec 3D system (version 2.9, Sirona) at the University of Leipzig (20 patients/21 crowns) and in a private practice setting (14 patients/20 crowns). The preparations were performed according the manufacturer's recommendations by the four dentists, who closely followed the guidelines of a detailed study protocol.

Optical impressions were taken of the preparation and additionally of a static and dynamic bite registration. If the individual maximal intercuspation of the opposing teeth allowed two or three centric stops on the molars and premolars, respectively, those contacts were maintained during design on the computer screen. Then, the crowns were milled from an IPS e.max CAD LT block constisting of bluish-colored metasilicate. The crowns were tried in to check the proximal, internal, and occlusal fit. Afterwards, they were sintered and glazed. Due to sintering, the cristalline structure changed from blue to a tooth-colored restoration. After the crystallization process, which was associated with a shrinkage of 0.3%, the crowns were tried in again. Whereas the tooth surface was simply cleaned carefully, the internal surface of the crowns had to be etched for 20 seconds with hydrofluoric acid (IPS Empress etch, Ivoclar Vivadent), thouroughly rinsed, and then silanized for 60 seconds (Monobond S, Ivoclar Vivadent). Then, the crowns were inserted with Multilink Sprint (Ivoclar Vivadent), a self-adhesive resin cement, and were polymerized from all directions for at least 40 seconds each (Fig 1). The static and dynamic occlusion were checked. At baseline and after 6, 12, and 24 months, all available crowns were examined according to modified United States Public Health Service criteria by two independent examiners, as described by Krämer et al[2] (Table 1).

Statistics, including a Kaplan-Meier survival analysis, were calculated using SPSS for Windows (version 15). With respect to the Kaplan-Meier analysis, the removal of a crown or the extraction of the abutment tooth due to complications were defined as a failure.

Table 2 Results of the Clinical Investigation for All Available Crowns (%)

	Baseline (n = 40)					6 mo (n = 38)				12 mo (n = 39)			24 mo (n = 39)				
	A1	A2	B	C	D	A1	A2	B	D	A1	A2	D	A1	A2	B	D	NA
Surface	82.5	17.5				76.3	23.7			71.8	28.2		76.9	23.1			
Color	50.0	50.0				36.8	63.2			48.7	51.3		61.5	38.5			
Adhesive gap	60.0	37.5	2.5			71.1	28.9			82.1	17.9		76.9	17.9	2.6	2.6	
Integrity: tooth	100.0					100.0				100.0			100.0				
Integrity: crown	100.0					100.0				100.0			100.0				
Proximal contact	50.0	50.0				42.1	55.3	2.6		48.7	51.3		46.2	48.7	2.6		2.6
Endodontic complications*	47.5	50.0		2.5		50.0	47.4		2.6	46.2	51.3	2.5	46.2	48.7		5.1	
Complaints	67.5	25.0	5.0		2.5	89.5	7.9	2.6		100.0			100.0				
Compliance	92.5		5.0	2.5		100.0				100.0			100.0				

A1 = excellent; A2 = good; B = sufficient; C = insufficient; D = poor; NA = not applicable (assessment not possible because adjacent tooth was extracted).
*Due to the fact that 20 of 41 teeth had received a successful endodontic treatment prior to restoration with a lithium disilicate crown, the criterion A1 describes a vital tooth, A2 describes a successful endodontic treatment before crown restoration, and D describes an endodontic treatment after crown restoration.

Results

After 24 months, 39 crowns in 32 patients (20 women, 12 men) between the ages of 28 and 76 (mean: 51 years) were assessed. All crowns were in situ; two abutment teeth lost their vitality. The adhesive gap of 1 crown was rated "poor" due to secondary caries. The margin of nearly 95% of crowns was rated "sufficient" or better. One proximal contact was rated "sufficient" because the gap between the crown and the adjacent tooth showed more than a 100-µm width but did not exhibit food impaction. At baseline, 1 patient had severe complaints that were eliminated by grinding off a premature contact. Table 2 shows the results of all assessed parameters from baseline to 24 months. Since the rating "poor" as a result of secondary caries could be regarded as a complete failure, the Kaplan-Meier analysis revealed a survival rate of 97.4% after 24 months.

Discussion

The increase in "excellent" ratings for the adhesive gap from 60% at baseline to 82.1% at the 12-month recall could be explained by the fact that slight composite resin excesses were removed after they had been discovered by the examiners at recall visits. One crown exhibited nonocclusion at baseline ("poor") but was assessed as "good" at the 24-month recall without any therapy of the antagonist or adjacent teeth. This fact could be contributed to the biologic flexibility of the oral system.

Conclusion

Within the limits of this study, especially its limited observation time, performance of the chairside-generated crowns seems to be comparable to other single-crown systems using similar evaluation criteria.[3–5]

Acknowledgments

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