# Retrospective Evaluation of CAD/CAM Cantilever Reconstructions to Restore Compromised Posterior Teeth: A Preliminary Report

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> **Purpose:** To describe the survival, clinical rating, and patient satisfaction of monolithic computer-aided design/computer-assisted manufacture (CAD/CAM) ceramic singleunit cantilever crowns placed on hemisected molars and premolars after a follow-up of at least 12 months. **Materials and Methods:** Sixteen consecutive patients (mean age, 56.8 years) with 16 restored two-unit cantilever crowns (5 premolars and 11 hemisected molar abutments) were reevaluated after an observation period of at least 12 months. Tooth mobility, plaque and bleeding scores, and pocket probing depths were assessed on both the restored and contralateral untreated teeth. Patient satisfaction was evaluated using a visual analog scale. **Results:** The mean observation time was  $25.7 \pm 13.1$  months. All restorations were in situ, and no significant biologic differences were observed between the treated and contralateral teeth. Clinical evaluation showed good performance, and patient satisfaction was recorded as excellent. **Conclusion:** The use of CAD/CAM ceramic single-unit cantilever crowns may be regarded as a conservative and cost-effective treatment modality with high patient acceptance in carefully selected patients. Int J Prosthodont 2014;27:165–168. doi: 10.11607/ijp.3514

Fixed dental prostheses with a cantilever design are characterized by the support of one or more abutment teeth while the cantilever part is not supported. This type of restoration is chosen either to avoid selecting an additional abutment or whenever suitable abutment teeth are not present. Single crowns with a cantilever design can also be used for the replacement of the missing coronal half of hemisected teeth. A recent methodologic paper has described the use of computer-aided design/computer-assisted

manufactured (CAD/CAM) cantilever crowns, which offer a conservative option for retaining periodontally or otherwise compromised mandibular molars by converting them into single-rooted teeth.<sup>1</sup> The aim of this preliminary retrospective report was to clinically evaluate hemisected molars and premolars restored using cantilever single crowns. It focuses on the survival, clinical rating, and patient satisfaction when using monolithic CAD/CAM ceramic single-unit cantilever crowns followed up for at least 12 months.

### **Materials and Methods**

For this retrospective report, consecutive patients from one author (PRS) were included. They were treated with CAD/CAM single crowns on premolars adjacent to a missing tooth or on hemisected molars to support a single cantilever pontic and were given a minimal wearing time of at least 12 months and a regular recall interval of at least one appointment per year. All patients contacted who qualified for this evaluation agreed to participate. Sixteen patients who had been mainly treated for periodontal reasons were analyzed. The cohort consisted of 5 men and 11 women with a mean age of  $56.8 \pm 14.3$  years. The mean service time of the restorations was  $25.7 \pm 13.1$  months (Table 1).

Cantilever CEREC (Sirona) two-unit restorations were placed on the remaining roots of hemisected

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#### Table 1 Patient and Restoration Characteristics

No. of patients	16
Sex: male/female (n)	5/11
Patient age (y): mean $\pm$ SD	56.8 ± 14.3
Tooth type: premolars/molars (n)	5/11
Cantilever position: mesial/distal	4/12
Restoration location: maxilla/mandible	2/14
Service time of the restoration (mo): mean $\pm$ SD	25.7 ± 13.1

#### Table 2 Modified USPHS Criteria for the Assessment of Adhesive CEREC Cantilever Reconstructions

		Definition
Marginal adaptation	А	Probe (Hu-Friedy no. 17/23) does not catch, smooth margin interface
	В	Probe catches at single spots, slight roughness
	С	Probe catches at 50% of margin length
	D	Probe catches at 100% of margin length, penetration of probe into adhesive gap
Integrity of crown	А	Completely intact
	В	Small, localized chipping, recontourable
	С	Extended chipping, dentin exposed, repair possible, limited crack line
	D	Fracture of crown/tooth, loss of crown
Anatomical form of crown	А	Contour completely matching to neighboring teeth
	В	Crown is slightly under/overcontoured (adjustment possible, accepted by patient)
	С	Crown is clearly under/overcontoured; still accepted by patient
Secondary caries at margin	А	No caries diagnosed clinically
	В	Superficial initial secondary caries, preventive measures
	С	Caries clinically localized, small filling needed
	D	Caries clinically and radiographically extended, replacement of crown
Surface texture of crown	А	Smooth, glazed natural appearing surface
	В	Single slight roughness spots on surface (can be polished)
	С	Glaze lost shine 50%, polishing reestablishes high gloss
Shade, color, and translucency of crown	А	No mismatch in shade or translucency between crown and adjacent teeth
	В	Slight mismatch between crown and adjacent teeth
	С	Distinct mismatch between crown and adjacent teeth; still accepted by the patient
Proximal contacts of crown	А	Physiologic strength of contact
	В	Weak but still sufficient contact
	С	Missing proximal contact
Occlusal contacts of crown in centric relation	А	Normal occlusal contact
	В	Premature occlusal contact
	С	Missing occlusal contact
Pro- and laterotrusion contacts of crown	А	Normal protrusion and laterotrusion contacts
	В	Slightly interfering protrusion/laterotrusion contacts
	С	Strongly interfering protrusion/laterotrusion contacts

A = excellent; B = good; C = borderline quality/acceptance, repair necessary/possible; D = complete failure, replacement necessary.

molars and single-rooted teeth without adjacent ones. These single crown abutments provided support for mesial or distal cantilever crown replacements (Fig 1) according to a previously described protocol.<sup>1</sup>

All patients who were treated using this method at least 12 months before were asked to participate voluntarily in the follow-up examinations after providing written and informed consent. Two independent examiners (AB and VR) assessed the reconstructed tooth as well as the contralateral tooth in the same arch. If the contralateral tooth was missing, the distal or, if not present, the mesial adjacent tooth was selected. The biologic parameters analyzed included presence or absence of plaque and bleeding on probing (six sites per tooth), presence of probing pocket depth of  $\geq$  4 mm (six sites per tooth), and tooth mobility (4 degrees; 0: physiologic; 1: 0.2 to 1 mm; II: 1 to 2 mm; III:  $\geq$  2 mm). Further, United States Public Health Service (USPHS) criteria<sup>2</sup> were applied after modification to suit the demands of rating bonded ceramic crowns (Table 2).<sup>3</sup> In the case of interexaminer

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Fig 1 Image of a premolar case (a) before treatment and (b) 24 months after reconstruction with a cantilever crown. The artificial "furcation area" was designed to create a periodontally friendly pontic (blue arrow). The area can be easily cleaned with interdental brushes. The USPHS rating for marginal adaptation was a "B" in this case.



had lost the mesial root of a mandibular first molar because of insufficient root filling accompanied by a periapical lesion. (a and b) Clinical situation before treatment. (c and d) Radiographs before and after the resection of the mesial root. (e and f) Clinical situation after healing of the extraction socket and core build-up with composite resin material. (g and h) Clinical situation after cementation of the CEREC cantilever crown. (I and j) Clinical situation after 28.5 months in situ.

disagreement, rating discrepancies were resolved by discussion. Further, periapical radiographs and photographs were taken. Finally, the patient was asked to rate his or her satisfaction regarding the restoration in terms of chewing comfort, cost-benefit ratio, incidence of muscle or joint problems, overall recommendation of treatment, and overall satisfaction by using a visual analog scale (VAS).

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	Test teeth	Р	Control teeth
Mobility Median (IQR)	0.9 ± 1.0 1.0 (1.5)	.0873	0.3 ± 0.7 0.0 (0.0)
Plaque (no. of sites) Median (IQR)	2.3 ± 1.8 2.0 (3.0)	.2664	2.8 ± 1.7 3.0 (2)
Bleeding (no. of sites) Median (IQR)	1.5 ± 1.1 1.0 (1.5)	.6248	1.1 ± 1.4 0.5 (1.5)
PD > 3 mm (min/max) Patients (n)	4.7 (4/5) 7	.2361	4.4 (4/6) 9

Table 3	Ratings of Test and Control Teeth
	(Mean $\pm$ SD)

IQR = interquartile range; PD = pocket depth.

Table 4	Modified USPHS Criteria at the 2-Year
	Examination

	Ratings: n (%)		
Rating criteria	A B	С	D
Marginal adaptation	8 (50) 8 (50)		
Integrity of crown	16 (100)		
Anatomical form of crown	10 (62.5) 6 (37.5)		
Secondary caries at margin	16 (100)		
Surface texture of crown	12 (75) 4 (25)		
Shade, color, and translucency	7 (43.7) 9 (56.3)		
Proximal contacts of crown	12 (75) 3 (18.7)	1 (6.25)	
Occlusal contacts of crown	13 (81.3)	3 (18.7)	
Protrusion and laterotrusion contacts	13 (81.3) 3 (18.7)		

### Results

At the time of clinical evaluation, all crowns were in situ without a history of repair, modification, or replacement. Figure 2 shows clinical images and radiographs of one of the treated patients. Table 3 presents the mobility, the plaque and bleeding scores, as well as the pocket probing depths of the test teeth, including the median as compared with the control teeth. No significant differences between test and control groups could be detected in any of the categories.

The evaluation of the USPHS criteria (Table 4) showed good results in all assessed parameters. In only four instances the rating "C" was given because of missing proximal or occlusal contact points. Analysis of the VAS showed very high patient satisfaction in all aspects (Table 5).

Table 5	Subjective Patient Rating as Indicated on the
	VAS (Mean $\pm$ SD)

	Overall satisfaction	Chewing comfort	Cost- benefit ratio	Muscle/ joint problems	Treatment recom- mendable
Rating	9.0 ± 1.7	9.2 ± 1.1	9.0 ± 1.4	$0.7\pm1.2$	$9.6\pm0.4$

VAS = visual analog scale.

## Discussion

A limitation of the present study is that this case series represents a retrospective evaluation of a rather small but well-selected patient population. The biologic assessment of the reconstructions showed comparable results of test and control teeth. The patient clientele investigated might explain the increased mobility in both groups; most of the patients lost their teeth/ roots because of periodontal disease and presented with a slight rest-mobility in the entire dentition even after completion of active periodontal treatment.

## Conclusion

Given careful patient selection and strict recall intervals, the introduced method represents a conservative and cost-effective treatment modality for cantilever reconstructions with high patient acceptance. Furthermore, alternative treatment options such as implant therapy or conventional fixed prostheses can be postponed. It is recognized that longterm outcomes that attest to the technique's efficacy and effectiveness are still to be determined.

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