Original Research

Clinical Evaluation of Full Coverage Crowns Ten Years after Placement

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Clinical significance

The results of this long-term follow-up report suggested that the initial periodontal condition of abutment teeth and the patient's oral hygiene seemed to affect the survival rate of crowns. It is also reconfirmed that following a standardized procedure could be one of the important factors leading to a favorable prognosis for the crown.

ABSTRACT

Purpose : The goal of this study was to clarify the frequency and reasons for crown failure, based on the longevity and quality of full coverage crowns evaluated in 226 patients.

Materials and Methods : Of a total of 529 patients who received full coverage crowns between 1980 and 1987 at the student clinic, 226 (42.7%) responded to a request to attend a recall examination. The crowns were fabricated and delivered in a uniform way according to the students' clinical manual used in the Department of Fixed Prosthodontics, School of Dentistry, Iwate Medical University.

Results : The 226 participants (61 men and 165 women with a mean age of 41.6 years) attended a recall examination between 1996 and 1997. Periodontal pocket depth was 2.2 ± 0.1 mm (mean $\pm$ S.D.) at the initial examination and 2.2 ± 0.8 mm (mean $\pm$ S.D.) at the recall examination. The gingival index at the initial visit indicated that 90.3% of recall subjects had either slight gingival inflammation or none at all. A 10-16 year follow-up examination on the 388 crowns revealed that 38 crowns (9.8%) were lost or replaced due to periodontal disease, caries, and/or fracture. Of the failed crowns, 19 abutments were extracted, 11 crowns were removed and remade as an abutment of a fixed bridge, and 8 crowns were replaced by new crowns. The survival rates of the crowns at 5, 10 and 16 years after placement were 96.9, 93.3, and 84.9%, respectively.

Conclusion : Although the recall rate of this follow-up study was low, it is suggested that the periodontal status at the initial stage of treatment played an important role in achieving a high survival rate of the crown. Following an approved procedural manual together with a fabrication manual and careful checking by a senior instructor were also thought to contribute to the excellent survival rate of the crowns.

Key words

full coverage crown, clinical evaluation, long-term prognosis, crown failure, survival rate

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INTRODUCTION

Because of the high prevalence of caries and periodontitis, full coverage crowns have become commonplace in effective treatment planning. Accordingly, knowledge as to why crowns deteriorate or fail is essential as a guide both to future improvements in clinical procedures and to which materials and techniques are optimal.

Previous researchers have reported on the frequency of crown failure and the reasons for failure, and used this information to estimate the expected longevity of fixed prostheses¹⁻⁴⁾. However, the clinical and laboratory procedures included in these studies were not standardized, and the manner in which the data were collected and analyzed varied considerably. These differences make it difficult to draw generalizable conclusions based on their findings. The need for further research to clearly define the longevity of fixed prostheses was a central theme of the symposium held at the 94th annual meeting of Japan Prosthodontic Society in 1996, entitled "The Effect of Prostheses on Healthy Life—Assessment of the Functional Period for Crowns and Bridges—"5).

Within this context, we conducted a study to further evaluate the longevity and quality of full coverage crowns constructed according to the standardized clinical and laboratory techniques at the student clinic of the Department of Fixed Prosthodontics, School of Dentistry, Iwate Medical University.

MATERIALS AND METHODS

The study population was collected from records in the student clinic of the Department of Fixed Prosthodontics. We requested all 529 patients receiving full coverage crowns between 1980 and 1987 to respond to an invitation to a

recall clinical examination. Basic demographic information had been obtained and baseline evaluation was performed at the first visit and on the day of crown placement. The reasons for crown placement and crown failure were determined by review of the patient's dental charts together with an interview of the patient. All patients underwent a clinical assessment at the recall examination. The clinical condition of the crowns was judged according to a standardized procedure.

The full coverage crowns for these patients were fabricated and delivered according to the students' clinical manual at the Department of Fixed Prosthodontics. The individual tray for abutment impressions was fabricated using copper or acrylic while the final impressions were constructed with either polysulfide or silicone rubber materials. The crowns were fabricated according to the students' clinical manual and luted with zinc phosphate cement.

RESULTS

Of the 529 patients contacted, 226 attended a recall examination between 1996 and 1997 (recall rate 42.7%). The main reasons for not attending the recall examination were illness (n=12, 2.3%), address change (n=21, 4.0%), not interested (n=6, 1.1%), no time available to come in for recall visit (n=19, 3.6%), and patient was deceased (n=14, 2.6%); 231 patients (43.7%) did not respond to the invitation. The age and gender distributions of the 226 participants are shown in Fig. 1. The mean age of the participants was 41.6 years, ranging from 18-75 years. The participants included 61 men (27%) and 165 women (73%). The patients' periodontal indices are summarized in Table 1. There were no data or indices showing significant differences between the intended sample and the participants.

Clinical ratings of 388 full coverage crowns were obtained from the participants at the 10-16 year examination. The crowns included 265 full cast-metal crowns, 113 porcelain-fused-to-metal crowns (PFM), and 10 resin-facing-to-metal crowns.

The most frequent reason for receiving a crown was deep caries in the abutment tooth ($n=205$, 52.8%), followed by acute or chronic

apical periodontitis ($n=67$, 17.3%). Of the 205 abutments, 120 had recurrent cavities around the restorations. Root canal treatment had been done for 381 abutment teeth. Of these, 362 abutment teeth had a cast-metal post and core ; 19 had a prefabricated post and core.

During the 10-16 year interval between crown placement and the follow-up examination, 38 crowns (9.8% of total ; 32 posterior and 6 anterior crowns) were lost or remade. The reasons for crown failure are summarized in Table 2. Nineteen abutments were extracted, 11 crowns were removed and remade as an abutment of a fixed bridge, and 8 crowns were replaced by a new crown (Fig.2). The dates when the crown was removed or the tooth extracted were found either by checking the patient's clinical chart or by interviewing the

Fig. 1 Age and gender distribution of the participants

Table 1 Comparison of demographic data and periodontal indices of the intended sample and the participants on the day of crown placement

	Intended sample	Participants	p-value	Statistics
Age (year)	39.7±12.7	41.6±11.1	0.03	Mann-Whitney U
Gender (male/female)	121/408	61/165	0.54	χ^2
Pocket depth (mm)	2.2±0.8	2.2±0.7	0.90	Mann-Whitney U
Gingival index (0-3)	0.6±0.6	0.6±0.6	0.84	χ^2

(mean±S.D.)

Table 2 Reasons for crown failure

Failure	Number of cases
Extracted (16 posterior and 3 anterior)	19
Posterior :	
Chronic marginal periodontitis	13
Recurrent caries	3
Anterior :	
Chronic marginal periodontitis	2
Root fracture	1
Changed treatment plan (10 posterior and 1 anterior)	11
Replaced by a new crown (6 posterior and 2 anterior)	8
Posterior :	
Chronic marginal periodontitis	4
Detached due to lack of retention	2
Anterior :	
Chronic marginal periodontitis	1
Recurrent caries	1

patient.

The data were analyzed using the Wilcoxon matched pair signed-ranks test. As shown in Table 3, periodontal indices revealed no significant difference between the initial visit and the recall examination. Increased tooth mobility was observed in six teeth only. The exposure of crown margins was observed in 64 teeth at the recall examination.

The survival rate of the crowns after placement is shown in Fig. 3. The 5-, 10- and 16-year survival rates were 96.9, 93.3, and 84.9%, respectively.

DISCUSSION

This study considered a broad spectrum of patients that would be typical of many dental practices. They were predominantly from the middle class economically, were highly motivated about their dental care, and had excellent dental hygiene. Most of the abutments on which the crowns were placed were non-vital and had

been referred from the endodontic department into the student clinic for post and core build-up, and full coverage crown placement.

This follow-up study showed a low recall rate of 42.7%, meaning that 60% of the possible data were lacking; the high drop-out rate might affect the results as bias. However, unless it had been stipulated that the patients had to participate in a 10 year follow-up as a condition for crown treatment, almost half of the patients would typically have a reason for not making themselves available for this type of survey. Overall, no index showed a significant difference between the intended sample and the participants, suggesting the low drop-out bias in this study.

Schwarz et al. reported that the mean longevity of fixed prostheses was 10.3 years⁶. However, failures due to the formation of dental caries occurred on an average after 11 years, compared with 6.8 years for crowns with insufficient retention. In contrast, our study found that the mean longevity of failed crowns was 12.3 years, indicating that failure did not occur soon

Fig. 2 Number of failed crowns and their corresponding longevity

Fig. 3 Survival rate of the crowns after placement

Table 3 Comparison of periodontal indices between initial visit and recall examinations

	Initial visit examination	Recall examination	p-value	Statistics
Pocket index (mm)	2.2±0.1	2.2±0.8	0.83	Wilcoxon test
Gingival index (0-3)	0.7±0.7	0.5±0.6	0.97	Wilcoxon test

(mean±S.D.)

after crown placement. Overall, 94.5% of the crowns survived for 16 years after placement. The mean longevity of failed crowns found in our study was substantially greater than in previously published studies^{1-4,6-12}). Although it is difficult to determine the factors contributing to such a low failure rate, we focused on two specific points: 1) the clinical procedures and laboratory were standardized in a uniform manner, 2) patients showed good periodontal conditions. It might be fair to say that these two points could contribute to maintaining good crown function for a long period.

Prior to our study, only a few studies examined the longevity and failures of fixed prostheses in patients treated at an academic dental center. Even less is known about the longevity of full coverage crowns that were placed by dental students at a teaching clinic. Because dental students lack the experience and technical skill compared with senior faculty, one might assume that these crowns would have poorer longevity. However, senior full-time faculty members closely supervised the students, and all treatment steps were checked and approved by the attending faculty. To maintain uniform accuracy of the fabricated crowns, accepted criteria for crown delivery included the following factors: 1) the marginal gap between an abutment and a crown was confirmed using a sharpened explorer to be less than 100 μm , 2) occlusal contacts were strictly adjusted with 35 μm thick articulating paper, and 3) proximal contact was checked by insertion of a 50 μm thick steel gauge. These criteria may partially explain the enhanced crown longevity that we observed.

Failures requiring tooth extraction occurred after an average of 8.1 years, and most failures resulted from periodontitis. In contrast, failures requiring a new crown replacement occurred earlier, after an average of 5.3 years. The most

common reasons were chronic periapical periodontitis (50%) and insufficient retention (25%). Only one tooth required replacement as a consequence of recurrent dental caries. These percentages of crown failure are relatively unique to our study.

Overall, it appears that the integrity of the crowns in our surveyed population was superior to that reported in other studies. Furthermore, most of the cases that failed despite root-canal retreatment for chronic periapical periodontitis failed because of the baseline severity of the disease. Additionally, 60% of the failures occurred between 8 to 12 years after placement, which is consistent with the hypothesis that failure resulted from changes in oral condition attributed to aging or declining oral hygiene. It is noteworthy that the number of missing teeth increased in 27 of 38 cases in which crowns failed during the study period. This finding raises the possibility that malocclusion following tooth extractions may also have contributed to the failure of the crown.

Nevertheless, our study reinforces the concept that the quality of the abutment teeth, the patient's oral hygiene and health, and multiple other conditions continue to influence the longevity of dental restorations; these are all areas for future quality improvements. To improve crown longevity even further, a careful evaluation of initial tooth conditions among the patients who receive crowns should be conducted, and concerted efforts should also be made to reduce periodontitis, periapical periodontitis, and recurrent decay.

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