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Recommended Citation

Durr-E-Sadaf, ., Ahmad, Z. (2011). Porcelain fused to metal (PFM) crowns and caries in adjacent teeth. *Journal of the College of Physicians and Surgeons Pakistan*, 21(3), 134-7.

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Porcelain Fused to Metal (PFM) Crowns and Caries in Adjacent Teeth

Durr-e-Sadaf and Muhammad Zubair Ahmad

ABSTRACT

Objective: To assess the discrepancies in marginal integrity and contact points of Porcelain Fused to Metal (PFM) crowns and its association with caries in adjacent teeth.

Study Design: Cross-sectional study.

Place and Duration of Study: Dental Section of the Aga Khan University Hospital, Karachi, from January to August 2009.

Methodology: Ninety six (96) patients with PFM crowns on maxillary and mandibular premolars and molars were included in this study. Single unit PFM crowns that were part of fixed bridge with at least one natural adjacent tooth were studied. PFM crown with no adjacent tooth or badly broken down teeth were excluded. Marginal integrity, contact points of PFM crowns and caries in adjacent teeth were assessed clinically and radiographically. The data was collected on a structured Proforma. Fisher's exact test was used for statistical analysis.

Results: Marginal overhang and marginal gaps on the mesial surfaces of PFM crowns were observed in 17.7% and 13.5% respectively. Tight contact points and open contacts of PFM crowns with adjacent teeth were 15.6% and 17.8% respectively on mesial surfaces. Caries were present in 33.3% and 20% of teeth present mesial and distal to PFM crowns respectively. The association of faulty contact points of PFM crowns with caries in adjacent teeth was found significant ($p < 0.001$). The association of marginal discrepancy with caries in adjacent teeth was found significant ($p = 0.002$).

Conclusion: A significant association of faulty contact points and margins of PFM crowns with caries in adjacent teeth was found.

Key words: Porcelain fused to metal (PFM) crowns. Marginal integrity. Contact points. Caries.

INTRODUCTION

In a traditional porcelain fused to metal (PFM) crown, the strength is provided by the metal substructure, and a porcelain veneer provides esthetics.¹ Porcelain fused to metal (PFM) crowns are used to restore badly broken down teeth to protect remaining tooth structure. It may also be responsible for maintaining occlusion and providing aesthetics.² Margins are unacceptable, if the gap between margins of the crown and tooth structure is greater than 50 μ m allowing insertion of the tip of the explorer inside.³ Marginal gap between the crown and the tooth may lead to microleakage and secondary caries (Figure 1A). Secondary caries beneath crown margins is considered the most frequent reason for failure of crowns and fixed prosthodontic treatment.^{4,5}

Defective cast crowns may also have adverse effects on adjacent teeth. Correct formation, location and size of contact points is essential. Any discrepancy in contact points leads to food impaction. Patients may find it

extremely difficult to keep clean an area of crown with faulty margins and contact points which may result in caries in adjacent teeth (Figure 1B). Therefore, the reproduction of contact points of proper size and location is essential for the success of the restoration.⁶ Acceptable contact points in full coverage crowns are those that allow the floss to pass through with the same amount of resistance offered by the other contacts in natural dentition.³

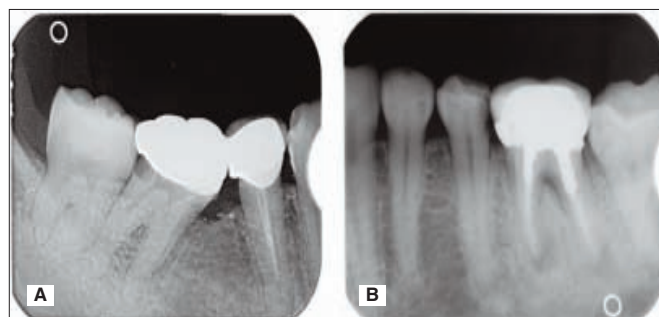


Figure 1 (A and B): (A). Caries beneath open margin of PFM crown on mandibular first molar. Note that distal margin of this crown is open. (B). Caries in mandibular second premolar adjacent to PFM crown on mandibular first molar.

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Received October 15, 2009; accepted February 14, 2011.

To our knowledge no research study has done so far to observe the effects of marginal discrepancy and faulty contact points of PFM crowns on adjacent natural teeth. Marginal integrity and contact points of PFM crowns were assessed clinically and radiographically. Diagnosis

of caries beneath crown margins with the help of radiographs is well documented.⁵

The objective of this study was to assess discrepancies in contact points and marginal integrity of PFM crowns and its association with caries in adjacent natural teeth.

METHODOLOGY

It was a cross-sectional study conducted from January to August 2009. Ninety six (96) patients visiting dental clinics at the Aga Khan University Hospital, Karachi, Pakistan with PFM crowns on maxillary and mandibular molars and premolar teeth were selected. The crowns were prepared by dental practitioners. Patients who gave informed consent were included in the study. The study was done after the approval of ethical review committee of the institution. PFM crowns as a single unit or part of bridge with at least one natural tooth adjacent to crown were included. PFM crowns with no adjacent tooth or badly broken down tooth were excluded. Both root-treated and vital teeth with PFM crowns were included. Clinical and radiographic assessment of contact points and marginal integrity of teeth with PFM crowns was done. Caries in teeth adjacent to PFM crowns was also recorded. Clinical assessment of contact points of PFM crowns was assessed with the help of dental floss. Contact points were categorized as acceptable, open contact points, tight contact points and lost contacts due to caries in adjacent teeth. Acceptable contact points were considered if dental floss could be passed with little resistance. Open contact points were those, which allowed the dental floss to pass without resistance. If dental floss shredded or could not be passed, it was categorized as tight contact points.

Marginal integrity of PFM crowns was assessed with bitewing and periapical views of digital radiographs. Marginal integrity was categorized as overhanged margins, intact margins, space beneath margins, and caries beneath margins. The data was collected on a structured proforma. It was analyzed using SPSS 17.0 and Fisher's exact test was used for statistical analysis to determine the association between distal crown margins and presence of caries in distal adjacent teeth, between distal contact points and presence of caries in distal adjacent teeth, between mesial crown margins and presence of caries in mesial adjacent teeth, between mesial contact points and presence of caries in mesial adjacent teeth. P-value of less than 0.05 was considered statistically significant at 95% confidence interval.

RESULTS

There were 50 (52.1%) male patients and 46 (47.9%) female patients. Mandibular first molars with crowns were 33.3% and maxillary first molars with crowns were

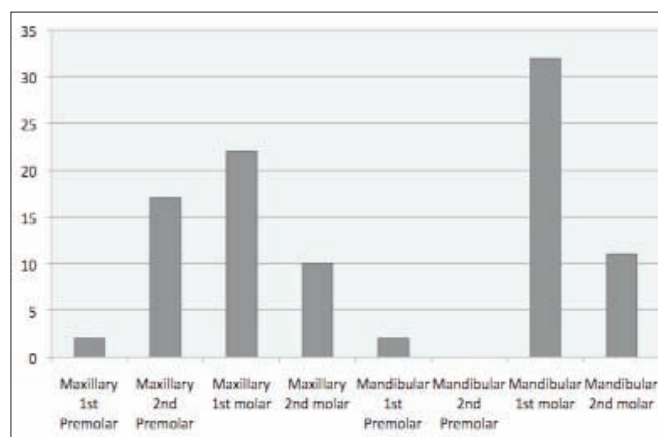


Figure 2: Distribution of teeth with PFM crowns.

22.9% (Figure 2). Single crowns were 82 (85.4%) and 14 (14.6%) were abutment and part of fixed denture. Crowns with root treated teeth were 65 (67.7%) and 31 (32.3%) were without any history of endodontic treatment.

Marginal overhang and marginal gaps on the mesial surface of crowns were 17 (17.7%) and 13 (13.5%) respectively. Marginal integrity was satisfactory in 65 (67.7%) of mesial surfaces (Table I).

Distal surfaces of crowns presented 10 (10.4%) marginal overhang and 17 (17.7%) marginal gaps. Marginal integrity on distal surface was satisfactory in 56 (58.3%) of surfaces (Table I). Caries was observed in 18 (20%) of teeth mesial to crowns and in 23 (33.3%) of teeth distal to PFM crowns (Table I).

The association of discrepancy in mesial margins of crowns with presence of caries in mesial adjacent teeth was found significant ($p = 0.003$). The association of discrepancy in distal margins of crowns with presence of caries in distal adjacent teeth was also found significant ($p = 0.021$) (Table I).

Tight contact points were observed in 14 (15.6%) on mesial surfaces and 20 (29%) on the distal surfaces of crowns. Open contacts were observed on distal surfaces in 20 (29%) and 16 (17.8%) were on mesial surfaces. Acceptable contact points were present on mesial surfaces in 51 (56.7%) and 24 (34.8%) were on distal surfaces of the crowns (Table I).

A significant association of faulty contact points with presence of caries in adjacent mesial teeth was found ($p < 0.001$). The association of faulty contact points with presence of caries in distal adjacent teeth was also significant ($p < 0.001$) (Table I).

Caries beneath margins of crowns were seen in 1 (1%) on mesial surfaces and 13 (13.5%) on distal surfaces. Contact points were lost on mesial surfaces due to caries in 9 (10%) of cases and on distal surfaces in 5 (7.2%) of cases.

Table I: Association of status of margins and contact points of PFM crowns with the condition of adjacent natural teeth. (Fisher's exact test is used at 95% Confidence Interval, $\alpha = 5\%$).

Crown margins	Mesial	Distal	Contact points	Mesial	Distal
Intact margins	65 (67.7%)	56 (58.3%)	Acceptable contact points	51 (56.7%)	24 (34.8%)
Overhang margins	17 (17.7%)	10 (10.4%)	Tight contact points	14 (15.6%)	20 (29%)
Space beneath margins	13 (13.5%)	17 (17.7%)	Loose/ Open contact points	16 (17.8%)	20 (29%)
Caries beneath margins	1 (1%)	13 (13.5%)	Lost contact points	9 (10%)	5 (7.2%)
			Missing	6 (6.25%)	27 (28.12%)
Status of adjacent natural teeth			Status of adjacent natural teeth		
Healthy	62 (68.9%)	34 (49.3%)	Healthy	62 (68.9%)	34 (49.3%)
Restored	10 (11.1%)	12 (17.4%)	Restored	10 (11.1%)	12 (17.4%)
Carious	18 (20%)	23 (33.3%)	Carious	18 (20%)	23 (33.3%)
Missing	6 (6.25%)	27 (28.12%)	Missing	6 (6.25%)	27 (28.12%)
P-value (Fisher's exact test)	0.002	0.017	P-value (Fisher's exact test)	< 0.001	< 0.001

DISCUSSION

The data obtained in this study showed marginal and contact points discrepancies in PFM crowns and caries in adjacent teeth. Discrepancies in contact points, marginal integrity and anatomic contour of the crowns may have adverse effects on surrounding tissues. Marginal integrity is one of the most important critical factors in success and failure of fixed restoration.⁶ Marginal defects were present in the form of overhang margins, space beneath margins and caries beneath margins in this study. Space beneath margins was observed to be the most common among all defects on distal surfaces and overhang margins were most common among all defects on mesial surfaces of PFM crowns.

Crown margins should blend with the tooth structure without overextension, marginal gaps and under extension.⁷ A study on clinical evaluation of all-ceramic crowns showed visible marginal discrepancy in 30% of all-ceramic crowns and 3% caries contiguous with the margin.⁷ The gap between the crown margins and the prepared tooth can dissolve dental cement leading to microleakage and caries development.⁹

Marginal discrepancies are related to irregular or absent tooth preparation margins, impression defects or casting shrinkage.¹⁰ Marginal discrepancy is seen more on distal margins of the crown than on the mesial margins in this study. It may be related to difficulty in access to distal surface while preparing teeth and difficult to establish well defined and smooth margins. Practitioners may face such problem in preparing distal surface of maxillary and mandibular first and second molars. Prevalence of marginal discrepancy in PFM crowns was observed to be up to 49% in a study.⁸

Porcelain fused to metal crowns with porcelain margins showed less fracture resistance than that with metal margins which should be considered by operator in treatment planning phase particularly in posterior teeth where heavy occlusal forces can cause fracture of restoration.¹¹ Discrepancies in contact points were observed in the form of tight contacts and open contact

points. One reason of tight contact points may be due to over contoured crown on proximal surfaces. It also reduces embrasure space. Reduced embrasure space results in broadening of the Col area, causing pressure and irritation on the papilla. Over-contoured crown decreases gingival embrasure leading to gingival inflammation and inhibit effective oral hygiene.^{12,13} Gordon suggested that the axial reduction of tooth structure should follow the original contour of the tooth so that final restoration is more close to the natural anatomy of that tooth.¹⁴ Frequently, dentists prepare the axial surfaces to be flat, forcing technicians to make over contoured crown with wide occlusal tables. Many times it may not be possible for even good technicians to overcome the discrepancies of preparation.

Tight contact points make the interdental area to floss extremely difficult for patients. It also makes the area highly susceptible for caries. In this study, faulty (tight, open or lost) contact points were associated with caries in adjacent teeth significantly. Contact points within normal limits were associated with less number of carious lesions in adjacent natural teeth. Tight contact points had greater association with presence of caries in adjacent natural teeth than open contact. Open contact also leads to food impaction which is a favorable environment for cariogenic bacteria and results in dental caries and gingival inflammation. Although open contact points make the area easily accessible for oral hygiene but it is not desirable because this condition may lead to several problems including drifting/tilting of adjacent tooth. In this study presence of carious lesion was observed less in teeth adjacent to crown with open contact points than those with tight contact points.

Greater discrepancies in contact points between crown and distal teeth were observed than that between a crown and mesial tooth.

Crown contours should facilitate plaque removal.¹² Ramfjord recommended placement of contact areas as far occlusally as possible to facilitate access for interproximal plaque control.¹⁵

Interproximal space slightly larger than normal may be desirable since it provides adequate room for the gingival

papilla and more accessible to clean.^{16,17} There are concerns regarding lateral impaction of food with open embrasures.¹⁶ However, another study reported that even with grossly undercontoured, open embrasure space, lateral food impaction rarely occurs as long as interproximal contacts are properly maintained.¹⁸

Another study on most common complication associated with fixed prosthesis showed caries incidence to be 0-2.7% in crowns and 0.7-26% in fixed partial dentures.⁸ Prevalence of secondary caries in crowned teeth is reported up to 11.2% when examined clinically and up to 8.3% when examined radiographically.⁵ Crowned tooth should be examined both clinically and radiographically. In a five year clinical study of posterior Cercon FPD's by Sailer *et al.*, secondary caries was found in 21.7% in crowned teeth.¹⁹ Presence of caries beneath margins was observed in 1% of mesial margins and 13.5% of distal margins in this study. Visible marginal discrepancy was found about 14% in all-ceramic crowns in a study.¹⁷ All ceramic crowns showed changes in the surface texture in areas of occlusal contact which may result in crack propagation leading to porcelain fracture, an occlusal splint should be considered for patients with heavy occlusal forces / parafunctional habits to prevent this situation.¹ This study showed marginal gaps in 13.5% of mesial surfaces and 17.7% of the distal surfaces of crowns.

It is recommended on the basis of results of this study that crown should be evaluated both clinically and radiographically before final cementation. At try in stage the margins and contact points of definitive crown should be assessed for any discrepancy. If any fault is detected it should be adjusted by the dental laboratory. After final cementation of the crown another bitewing radiograph should be taken to check the excess cement which if present should be immediately removed.

CONCLUSION

Faulty contact points of PFM crowns are found to be associated with presence of carious lesions in adjacent natural teeth significantly. Discrepancies in crown margins are associated with presence of caries in adjacent teeth significantly. Caries beneath crown margins are also found frequently in such cases. Marginal discrepancies and defective contact points are seen more commonly on the distal surfaces of crowns than on the mesial surfaces. Presence of carious lesions is seen more commonly on the teeth distal to PFM crowns than those on the mesial to the PFM crowns.

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