

## Analysis of Type of Proximal Contact Points of Porcelain Fused to Metal Crowns and Caries in Adjacent Teeth

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### ABSTRACT

**Objective:** The objective of this article is to investigate the association between the type of mesial and distal proximal contact points of Porcelain Fused to Metal crowns and the occurrence of caries in adjacent teeth.

**Materials and Methods:** From September 2019 to February 2020, the cross-sectional study was carried out at the Department of Prosthodontics, Armed Forces Institute of Dentistry, on hundred post-treatment patients with Fixed Dental Prostheses (FDPs). The patients were recalled for follow-up after 3 months regarding the clinical evaluation of mesial and distal proximal contact points using dental floss and were graded as acceptable, open and tight. Bitewing and periapical radiographs were obtained by the operator to assess caries at the cementation and follow-up appointments.

**Results:** The frequency of contacts observed on the mesial aspect was 70% acceptable, 12% open and 18% tight. The frequency of contacts observed on the distal aspect was 40% acceptable, 48% open and 12% tight. Caries were present in 36% of the mesial aspect and 34% on the distal surface of the adjacent tooth. A significant difference was observed between caries presence and contact type observed for both mesial and distal aspects ( $p < 0.001$ ).

**Conclusion:** The study highlights that open and tight contact points are linked to an increased risk of caries development in teeth adjacent to porcelain fused to metal crowns.

**Keywords:** Dental Caries, Fixed Partial Denture, Proximal Contact Points, Porcelain-Fused-to-Metal Crowns

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## INTRODUCTION

Considering the significant risk of caries faced by prosthodontic patients, it is crucial to assess this risk before starting treatment. Better diagnosis and advancement in techniques for caries management have been made possible by recent breakthroughs in dentistry research.<sup>1</sup> Dental caries is mostly caused by two bacterial species.<sup>2</sup> According to the evidence, streptococci mutans are linked to caries initiation, whereas lactobacillus is linked to the development and progression of caries.<sup>3</sup>

Fixed dental prostheses can be used to replace lost teeth, reconstruct severely damaged teeth while preserving the remaining tooth structure, and serve as a retainer for fixed partial dentures (FPDs). Fixed dental prostheses provide significant retention, stability, and comfort, making them the next-best choice after implants.<sup>4</sup> The reported mean life span of fixed partial dentures is 10.3 years.<sup>5</sup> They play a key role in the maintenance of occlusion, function, and providing esthetics.<sup>6</sup>

Inadequate crowns may harm adjacent teeth as well. Contact points should be appropriately shaped, positioned, and sized. Any difference in contact points might cause food to get stuck between adjacent teeth, making it challenging for the patient to keep the portion of the crown with flawed margins and contact points clean and ultimately leading to caries in adjacent teeth.<sup>7</sup> The floss must be able to pass through full coverage crown contact points with the same level of resistance as the other contacts in the natural dentition.<sup>8</sup>

According to a study conducted by Papageorgiou SN et al on FPD complications dental caries was shown to be the second most frequent complication over 5 years.<sup>2</sup> In one of the studies reported by Lalloo R et al, it was shown that up to 15% of the abutments of fixed partial dentures that are vital may at some point in time require endodontic treatment, compared with only 3% of vital non-abutment teeth that have crown preparations.<sup>3</sup> Another study showed that the need for endodontic treatment was the least in mandibular posteriors when they were used as vital abutments of fixed partial dentures.<sup>9</sup>

When a new prosthesis is made, the proximal contact points must be inspected before final cementation both intra-orally and during the try-in stage on the cast. Tight and open proximal contact points provided evidence of

proximal contact point differences. Overly curved crowns on proximal surfaces could be one cause of tight contact points. Hence, the axial reduction of tooth structure should follow the original shape of the tooth so that the final restoration is more similar to the natural anatomy of that tooth. It also reduces gingival embrasure, which leads to gingival irritation and inhibits proper oral hygiene.<sup>10</sup> To increase the frequency of detection of proximal caries, authors have recommended that visual and clinical examination be combined with a bitewing radiograph.<sup>11</sup>

The study might not have considered individual patient factors such as oral hygiene practices, diet, and systemic health conditions that could influence caries development. Exploring the influence of these variables in relation to faulty contact points could be a research gap to be addressed.

In summary, conducting a study on the frequency, location, and relationship between proximal contact points of porcelain fused to metal crowns and caries in adjacent natural teeth is important for enhancing clinical decision-making, optimizing treatment outcomes, and improving patient care.

This study aims to identify variations in porcelain fused to metal crown contact points and their relationship to caries in adjacent teeth. Optimal knowledge of the contours of mesial and distal contact points can lead to the longevity of the crown as well as the adjacent natural tooth. We can apply the study results in future for better treatment planning of the fixed prostheses and their implementation for improved patient care and decreased risk of associated failures leading to long-term oral health for patients with porcelain fused to metal crowns.

## MATERIALS AND METHODS

This current cross-sectional study was conducted at the Armed Forces Institute of Dentistry from September 2019 to February 2020 in the Department of Prosthodontics. Permission to collect data from participants and ethical clearance was obtained from the Institutional Review Board and ethics committee before initiation of the study. The patients presenting to the prosthodontics department requiring fixed partial dentures were considered for enrollment in the study. Those fulfilling the inclusion criteria of age 18 to 80 years, either gender and consenting to participate in the

study were selected for enrollment. Medical history was obtained from all enrolled patients followed by a complete oral examination, after obtaining verbal and written informed consent. The fixed partial dentures were cemented and post-cementation instructions were given. The patients were recalled for a follow-up visit after 3 months for clinical evaluation of the crown contact points and caries. Bitewing and periapical radiographs were obtained by the operator at the cementation and follow-up appointments after 3 months. Patient data were entered in a specifically designed data collection tool at baseline and each follow-up visit.

For statistical analysis, the data were entered into IBM SPSS (version 23.0) software. The descriptive statistics of continuous data were reported as mean/standard deviation while for categorical data, frequency and percentages were reported. The outcome variable, the presence of caries (yes/no) at follow up was categorical, similarly, the independent variable which is the type of contact (open, acceptable, tight) was also categorical. The dependent and independent categorical variables were compared by applying the chi-square test. Results were stratified according to age, gender and type of arch

involved. The *p*-value of  $\leq 0.05$  was considered significant.

**RESULTS**

There were hundred (n=100) patients selected for this study, where 48 (48.0%) were males while 52 (52.0%) were females. Around 47 (47.0%) patients belonged to the age group of 25-40 years, whereas 53 (53.0%) belonged to 41-55 years of age. Table 1 gives a basic summary of the demographic characteristics of the study participants. There was involvement of anterior and posterior teeth among 29 (29.0%) and 71 (71.0%) respectively. On the other hand, the maxillary and mandibular arch was involved in 31 (31.0%) and 69 (69.0%) patients respectively.

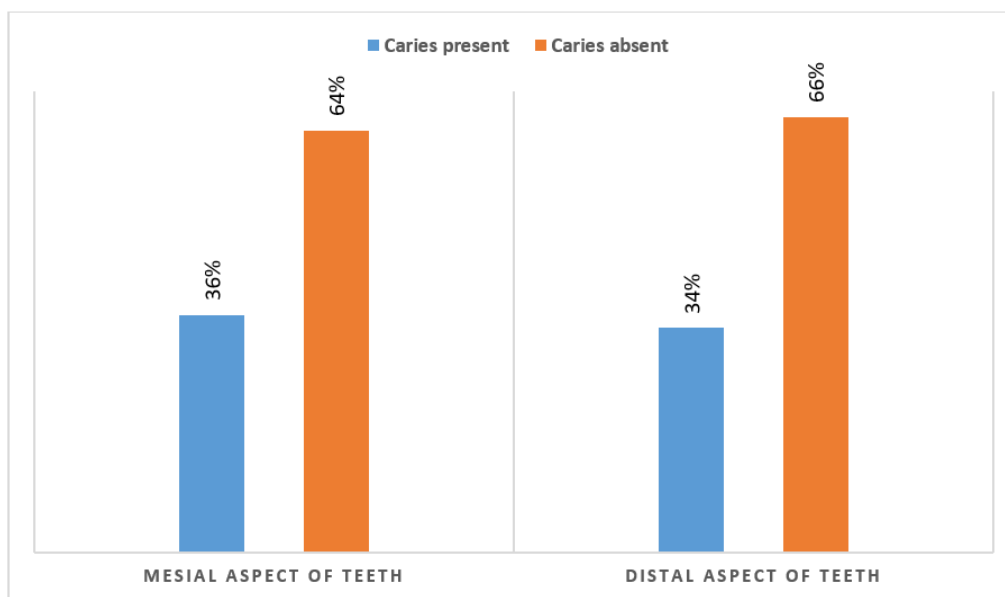
Contact points were grouped into open, acceptable, and tight on both the mesial and distal sides of the crown. The frequency of the type of contact as per mesial and distal aspects is summarized in Table 2. On the mesial side, the type of open contact was in 12 (12.0%) patients, acceptable in 70 (70.0%) patients and tight in 18 (18.0%) patients. Whereas, in the distal area, the type of contact was open, acceptable and tight for 48 (48.0%), 40 (40.0%) and 12 (12.0%) patients.

**Table 1: Summary of baseline demographic characteristics (n=100)**

Characteristics	Frequency (n)	Percentage (%)
Gender		
Males	48	48.0%
Females	52	52.0%
Age groups		
25-40 years	47	47.0%
41-55 years	53	53.0%
Location of teeth		
Anterior	29	29.0%
Posterior	71	71.0%
Arch involved		
Maxilla	31	31.0%
Mandible	69	69.0%

**Table 2: Frequency distribution of type of contact observed on mesial and distal aspects of the teeth (n=100)**

Type of contact	Mesial aspect (n=100)	Distal aspect (n=100)
Open Contact	12 (12.0%)	48 (48.0%)
Acceptable contact	70 (70.0%)	40 (40.0%)
Tight contact	18 (18.0%)	12 (12.0%)



**Figure 1: Comparison of percentage distribution of presence or absence of dental caries after 3 months follow up at mesial and distal aspects of teeth**

Upon 3-month follow-up, there was dental caries present in 36 (36.0%) patients on the mesial aspect, while dental caries was present in 34 (34.0%) patients at the distal aspect as shown in Figure 1.

A significant correlation exists between the occurrence of dental caries in teeth adjacent to porcelain fused to metal crowns with defective mesial and distal proximal contact points. Among patients who had tight contact at the mesial area, dental caries was present in 17/18 (94.4%) patients as compared to the presence of caries in those with open 9/12 (75.0%) and acceptable 10/70 (14.2%) contact ( $p < 0.001$ ). Similarly, among patients who had tight contact at the distal area, dental caries was present in all 12 (100%) patients, while in those with open and acceptable contact, caries was present in 20/48 (41.6%) and 2/40 (5.0%) patients respectively

( $p < 0.001$ ) as shown in table 3.

Table 4 shows the association of dental caries at three months follow up with gender, age, tooth location and arch involved. It is observed that a significant association existed between age group and dental caries on the distal aspect of a tooth, which reflects that caries was more frequently developed in patients belonging to the younger age group as compared to the older age group at three months follow up ( $p = 0.034$ ). Similarly, a significant association existed between tooth location and dental caries. More dental caries were observed at the posterior tooth location at the mesial tooth aspect as compared to the anterior tooth ( $p = 0.04$ ), a similar trend was noted for the distal tooth aspect ( $p < 0.001$ ) as shown in Table 4.

**Table 3: Association of dental caries with the type of contact at mesial and distal aspects of teeth after 3 months post prostheses follow-up (n=100)**

Type of contact	Dental caries at 3-month follow-up					
	Mesial aspect		p-value	Distal aspect		p-value
	Present (n=36)	Absent (n=64)		Present (n=34)	Absent (n=66)	
Open Contact	9 (75.0%)	3 (25.0%)	<0.001	20 (41.6%)	28 (58.3%)	<0.001
Acceptable contact	10 (14.2%)	60 (85.7%)		2 (5.0%)	38 (95.0%)	
Tight contact	17 (94.4%)	1 (5.5%)		12 (100.0%)	0 (0.0%)	

**Table 4: Association of dental caries with gender, age, tooth location and arch involved at 3 months follow up (n=100)**

	Dental caries at 3-month follow-up					
	Mesial aspect		p-value	Distal aspect		p-value
	Present (n=36)	Absent (n=64)		Present (n=34)	Absent (n=66)	
<b>Gender</b>						
Male	17 (47.2%)	31 (48.4%)	0.907	18 (52.9%)	30 (45.4%)	0.56
Female	19 (52.7%)	33 (51.5%)		16 (47.0%)	36 (54.5%)	
<b>Age groups</b>						
25-40 years	18 (50.0%)	29 (45.3%)	0.652	21 (61.7%)	26 (39.3%)	0.034
41-55 years	18 (50.0%)	35 (54.6%)		13 (38.2%)	40 (60.6%)	
<b>Tooth location</b>						
Anterior	6 (16.6%)	23 (35.9%)	0.04	1 (2.9%)	28 (42.4%)	<0.001
Posterior	30 (83.3%)	41 (64.0%)		33 (97.0%)	38 (57.5%)	
<b>Arch involved</b>						
Maxilla	11 (30.5%)	20 (31.2%)	0.943	12 (35.2%)	19 (28.7%)	0.505
Mandible	25 (69.4%)	44 (68.7%)		22 (64.7%)	47 (71.2%)	

**DISCUSSION**

The results obtained in this study revealed variations in contact points in the form of tight, open and acceptable. Over-contouring of proximal surfaces results in tight contact points. Gordon proposed that when a tooth is reduced axially, the original contour of the tooth structure should be maintained, bringing the final restoration closer to the tooth's natural anatomy.<sup>12</sup> The axial surfaces of teeth are frequently made flat by dentists, which compels lab technicians to create over-contoured crowns with wide occlusal tables. Making it tough for even skilled professionals to get beyond the gaps in planning. For patients with tight contact points, flossing the interdental area is especially challenging. Hence, the region is highly prone to dental caries.<sup>13</sup>

A strong correlation between the defective (tight or open) contact points and caries in adjacent natural teeth was discovered in this investigation. Appropriate contact points were linked to fewer carious lesions on adjacent healthy teeth. Tight contact points were shown to be more closely associated with carious lesions in natural teeth than open contact. Open contact points can contribute to food impaction, creating a favourable environment for cariogenic bacteria and leading to dental caries and gingival inflammation. While open contact points are more accessible for oral hygiene practices, they are still considered undesirable due to the potential occurrence of additional problems such as

drifting or tilting of adjacent teeth.

In this study, it was found that teeth next to porcelain fused to metal crowns with open contact points had fewer carious lesions than teeth with tight contact points. Distal contact points between natural teeth and the crown exhibited more noticeable discrepancies, while fewer discrepancies were observed on the mesial side between the crown and the adjacent tooth.

It is preferable to have slightly greater interproximal space than usual since it allows enough area for the gingival papilla and makes cleaning easier.<sup>14,15</sup> Regarding the lateral impaction of food with open embrasures, there are several worries.<sup>14</sup> A different study, however, found that as long as interproximal contacts are kept in good condition, lateral food impaction rarely happens even in embrasure spaces that are grossly under-contoured and open.<sup>15</sup> For the dental alveolar complex to remain healthy and durable, the optimal proximal contacts in natural teeth and restorations are crucial. In a study conducted by Ahmed Z et al on 96 (47.9% females, 52.1% males) patients, it was reported that 33.3% of mandibular first molars and 22.9% of maxillary first molars had crowns. It was also reported that 82 (85.4%) single crowns and 14 (14.6%) abutments and fixed denture components were used, while 65 (67.7%) of the teeth had crowns with root canal therapy, and 31 (32.3%) had no prior endodontic care. On the mesial surfaces of 14 crowns (15.6%) and the



distal surfaces of 20 crowns (29%) tight contact sites were seen. Twenty (29%) surfaces had open contacts, while 16 (17.8%) surfaces were mesial. 51 (56.7%) of the crowns had acceptable contact points on their mesial surfaces, and 24 (34.8%) of them had them on their distal surfaces.<sup>16</sup>

Our study showed that the frequency of contact observed on mesial was acceptable in 70%, open in 12% and tight in 18% of participants, while the frequency of contact observed on distal was acceptable in 40%, open in 48% and tight in 12% of participants. Caries were present in 36% of subjects on the mesial and 34% on the distal surface. Based on the findings of this study, it is advised that the crown be examined both clinically and radiographically before final cementation. The dental laboratory should correct any errors that are found. Another bitewing radiograph should be performed following the final cementation of the crown to check for any excess cement, which, if found, should be removed right away.

### CONCLUSION

The study may have certain limitations as it did not account for individual patient factors, like oral hygiene practices, diet, and systemic health conditions, which could potentially impact the development of dental caries. Therefore, it can be concluded within these limitations that a strong correlation exists between the occurrence of carious lesions in teeth adjacent to porcelain fused to the metal crown with defective proximal contact points. Defective contact points are more frequently observed on the distal surfaces of crowns rather than the mesial surfaces. Tight contacts were linked to a higher frequency of caries, and carious lesions are more frequently found on teeth distal to PFM crowns than those mesial to the PFM crowns.

### DISCLAIMER

None.

### CONFLICT OF INTEREST

None to declare.

### ETHICAL STATEMENT

The ethical approval is provided by the Research Ethics Committee of the Armed Forces Institute of Dentistry (Ref.905/Trg-ABP1K2).

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### AUTHORS CONTRIBUTION

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Critical review of the manuscript: M. Shad

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### REFERENCES

1. Featherstone JDB, Singh S, Curtis DA. Caries risk assessment and management for the prosthodontic patient. *J Prosthodont*. 2011;20(1):2-9.
2. Papageorgiou SN, Papadelli AP, Koidis PT, Petridis HP. The effect of prosthetic margin location on caries susceptibility. A systematic review and meta-analysis. *Br Dent J*. 2013;214(12):617-24.
3. Abbass M, Mahmoud S, El Moshy S, Rady D, AbuBakr N, Radwan I, et al. The prevalence of dental caries among Egyptian children and adolescences and its association with age, socioeconomic status, dietary habits and other risk factors. A cross-sectional study. *F1000Research*. 2019;8(8):1-19.
4. Fuga E, Shtino G. Complaints of patients wearing metal ceramic fixed partial dentures. *Alban Med J*. 2018;2(1):25-9.
5. Rechmann P, Chaffee BW, Rechmann BMT, Featherstone JDB. Caries Management by Risk Assessment: Results from a Practice-Based Research Network Study. *J Calif Dent Assoc*. 2019;47(1):15-24.
6. Qayyum Akhtar SD, Zareen S, Ahmed B, Maqsood M, Azad AA. Clinical evaluation of proximal contact points in fixed prostheses. *J Col Physicians Surg Pak*. 2015;25(9):702-4.
7. Hassan SH, Azad AA, Niaz O, Amjad M, Akram J, Riaz W. Post cementation sensitivity in vital

- abutments of metal-ceramic fixed partial dentures. *Pak Oral Dental J.* 2011;31(1):17-24.
8. Laloo R, Tadakamadla SK, Kroon J, Tut O, Kularatna S, Boase R, et al. Salivary characteristics and dental caries experience in remote Indigenous children in Australia: a cross-sectional study. *BMC Oral Health.* 2019;19(1):1-921.
  9. Spanemberg JC, Cardoso JA, Slob EMGB, López-López J. Quality of life related to oral health and its impact in adults. *J Stomatol Oral Maxillofac Surg.* 2019;120(3):234-9.
  10. Reitemeier B, Hansel K, Walter MH, Kastner C, Toutenburg H. Effect of posterior crown margin placement on gingival health. *J Prosthet Dent* 2002;87:167-72.
  11. Srimaneepong V, Heboyan A, Zafar MS, Khurshid Z, Marya A, Fernandes GV, Rokaya D. Fixed prosthetic restorations and periodontal health: a narrative review. *J Funct Biomater.* 2022;13(1):15.
  12. Chitra S, Mathew NK, Jayalakshmi S, Balakumar S, Rajeshkumar S, Ramya R. Strategies of Bioceramics, Bioactive Glasses in Endodontics: Future Perspectives of Restorative Dentistry. *Biomed Res Int.* 2022;2022:1-12.
  13. Srimaneepong V, Heboyan A, Zafar MS, Khurshid Z, Marya A, Fernandes GV et al. Fixed prosthetic restorations and periodontal health: a narrative review. *J. Funct. Biomater.* 2022;13(1):15-22.
  14. Das AC, Panda S, Kumar M, Mohanty SK. Surgical Clinical Crown Lengthening: A Prerequisite for Crown Placement in Fractured Teeth. *Indian J Public Health.* 2019;10(09):1601-9.
  15. Almalki AD, Al-Rafee MA. Evaluation of presence of proximal contacts on recently inserted posterior crowns in different health sectors in Riyadh City, Saudi Arabia. *J Family Med Prim Care.* 2019;8(11):3549-3553.
  16. Suarez MJ, Perez C, Pelaez J, Lopez-Suarez C, Gonzalo E. A randomized clinical trial comparing zirconia and metal-ceramic three-unit posterior fixed partial dentures: a 5-year follow-up. *J Prosthodont.* 2019;28(7):750-6.