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Original Article

COMPARISON OF INTER-PROXIMAL CONTACT BETWEEN ALL-METAL CROWN VS PORCELAIN FUSED TO METAL CROWN IN POSTERIOR TEETH. A COMPARATIVE CROSS-SECTIONAL STUDY

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ABSTRACT

Objectives: *The objective of this study was to evaluate the frequency of loose Inter-Proximal Contacts (IPC) in All-Metal and PFM crowns and to determine association of loose IPC with age, gender, dental arch, surface of crown, duration of crown and type of crown.*

Materials and Methods: *This comparative cross-sectional study was conducted in Prosthodontic department of Khyber College of Dentistry, Peshawar, Pakistan. Files records of patients for the last 11 years, who received single crown or as retainer for fixed partial denture for posterior teeth and had follow up visit for the evaluation of inter-proximal contact (IPC) between crown and adjacent tooth/teeth were included. Type of crown was divided into two groups; All-metal and Porcelain fused to metal (PFM) crown. Outcome measure that is, type of IPC was labeled as Acceptable and loose. Frequencies, chi-square and Logistic regression analysis was used to determine prevalence, association and strength of association of IPCs with age, gender, arch, surface, duration and type of crown.*

Results: *There were 150 crowns related to 100 patients. The mean age of patients was 45.1±12.1 years. Out of 150 crowns, 98 (65.3%) were PFM and 52 (34.6%) were All-metal crowns, leading to the assessment of 279 IPCs on proximal surfaces. Among 279 IPCs, 194 (69.5%) were acceptable and 85 (30.5%) were loose. Among PFM crowns, 36.6% of IPCs were loose comparing to 20.2 % in metal crowns. There was statistically significant association of type of IPC with type of crown (chi =0.004, OR= 2.52, 95% CI 1.4–4.6, p=0.002), dental arch (chi=0.025, OR=0.52 95 % CI 0.298-0.915, p=0.023), and surface of crown (chi= 0.047, OR= 1.7, 95% CI 1.004-2.917, p=0.048). No significant association of type of IPC was found with gender and age.*

Conclusion: *In comparison with Metal crowns, PFM crowns manifested three times more loose IPC.*

Key words: *All-Metal crown, Contact points, Food impaction, Inter-Proximal contact, Loose inter-proximal*

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INTRODUCTION

A crown is an extra-coronal restoration that is cemented to natural teeth[1]. It can be used to strengthen endodontically treated teeth, to change occlusion, to change contour of tooth, to restore gross carious teeth and as a retainer for tooth sup-

ported fixed partial denture[2].According to materials, crown can be classified as all-metal (cast metal) crown, All-ceramic crown and porcelain fused to metal (PFM) crown. Advantages of all-metal crown include: more tooth preservation, low cost, does not wear opposing natural tooth, good adapted margins and more strength1. The only disadvantage of metal crown is esthetics/color because it appears black or metallic[3]. PFM crown has the advantage of natural tooth color resemblance but disadvantages are: more tooth reduction, reduced strength, more cost, causes abrasion of opposing tooth and difficulty in adaptation of margins[4].

Inter-proximal contact (IPC) area has been defined as the area of a tooth that is in close association, connection, or contact with an adjacent tooth in the same arch[5]. Proper IPC is important for efficient function[6]. IPC can be classified as tight, acceptable (optimal) and loose (open). Excessively tight IPC causes incomplete seating of crown and intrusion of adjacent teeth, which leads to patient discomfort and making it difficult to floss interdental area[7,8].

Loose (open) IPC leads to food impaction, which is one of the most common complications reported by the patients associated with the crown[9-11]. Webster defines food impaction as food being wedge or packed between teeth[12]. Most common complaints reported by the patient related to food impaction are bleeding gums, halitosis (bed breath) and pain during chewing of food. The most common consequences of food impaction are caries of adjacent teeth, caries of abutment teeth, pocket formation and internal bone loss, all leading to subsequent failure of crown[13,14].

The proximal contact tightness can be assessed using two types of measurements: i.e. quantitative and qualitative methods. The quantitative methods include metal strip and pulling gauge method and Stereoscopic microscope[15].Qualitative measurement includes; Dental floss method., Explorer, Radiograph, Mylar Shim stock, dental film and Articulating paper[16]. As it has been observed from clinical experience and a descriptive study by Akhtar Q, that IPC associated with metal crown has less chances of loose/open contact (23%) as compared to PFM crown (30%)[17]. Most common method to evaluate IPC is to pass dental floss between contact areas. In case of optimal or normal IPC dental floss should pass with some resistance[17,18].

To our knowledge no research study has been done so far to observe the effects of different factors specifically type of material associated with IPC of dental crowns. The available literature emphasizes the complications resulting from either of the two types of crowns. As loose IPC is the most common complication associated with crowns, it is important to study the related factors. The dearth of knowledge about this problem does pose a question that whether loose IPC are related with the type of material from which the crown is made. For this purpose, we aimed to assess the effect of both metal and PFM crown on IPC. The objective of this study was to evaluate the frequency of loose IPC in Metal and PFM crowns and to determine association loose IPC with gender, age, type of arch, surface of tooth and duration of crown in the mouth.

MATERIALS AND METHODS

This Comparative cross-sectional study was carried out in June, 2024 to December 2024, utilizing clinical records of the patients receiving metal and PFM crowns placed at the Prosthodontic department Khyber College of Dentisrty, Peshawar, Pakistan. Ethical approval for the study was granted by ethical review board of Khyber Medical University, Peshawar, Pakistan (KMU/IPHSS/Ethics/2023/CO/0170). By using WHO sample size calculator and considering 23% of loose IPC associated with metal crown15, p-vale ≤ 0.05 and with 95% confidence interval, the sample size calculated to be was 273 IPC. But in our study Census sample size technique was used and all the data available for the last 11 years was analyzed.A total of 100 patients with 150 crowns making 279 IPC were included according to inclusion and exclusion criteria.

Inclusion criteria was file records of subjects treated in Prosthodontic department of KCD for Metal and PFM crowns during the period of last 11 years (May 2013 to May 2024), treated by the same dentist and same laboratory and having secondary follow up visit. The post cementation follow-up duration from 1st visit was minimum of 6 months or more. Only the crowns on posterior teeth were evaluated. Exclusion criteria was those crowns with adjacent missing teeth or having caries in adjacent teeth drifting, rotation or supra-eruption (of the adjacent tooth and the abutment tooth to be examined), chipping of proximal portion of porcelain, grade II

or III mobility (of the adjacent and the abutment tooth to be examined), those who recently finished orthodontic treatment.

The crowned teeth were divided into two groups according to type of material; Group A having Metal crowns and Group B having PFM crowns. The method used to assess condition of IPC for all the cases was the use of 9 inch Nylon unwaxed Dental Floss with thickness of 50 µm (Oral-B, USA) 15, 16. The IPC were categorized as acceptable or loose. Acceptable contact points were considered if dental floss could be passed with some resistance. Loose contact points were those, which allowed the dental floss to pass without resistance. The data were collected on a structured proforma.

Independent variables were subject's age, gender, duration of crown in mouth, dental arch (maxillary or mandibular arch), surface of crown (mesial or distal) and type of crown (metal or PFM). Dependent variable was type of IPC (Acceptable or loose).

The SPSS version 22 was used for statistical analysis. For numerical variables like age and duration, means and standard deviation were calculated. For primary objective, frequency of loose IPC in PFM and metal crowns was presented in form of tables and charts. Chi square test was used to assess the association between independent and dependent variables. A P-value 0.05 and less was considered as statistically significant. Binary Logistic regression analysis was undertaken to determine strength of association and confounding factors between independent and dependent variables. The Hosmer-Lameshow test was used to assess the adequacy of the models.

RESULT

There was 100 patient's files record out of which 49 were male and 51 female. Mean age of the participants was 45.1±12.1 years and the mean duration of follow up visit after cementation was 3.6±2.3 years. One hundred and fifty crowns were evaluated. Out of 279 IPCs, 175 (62.7%) were associated with PFM and 104 (37.3%) with metal crown. Out of 175 PFM crown's IPCs, 111 (63.4%) were acceptable, and 64 (36.6%) were loose. While 0ut of 104 metal crown's IPCs, 83 (79.8%) were acceptable and 21 (20.2%) loose. Most commonly tooth with crown was maxillary first molar and mandibular first molar (table 1 and fig 1). The type of IPC was significantly associated with type of crown, type of arch and surface of crown (table 2). There was no significant association of type of IPC with covariates of age, gender, duration of crown and location of crown. Binary Logistic regression analyses confirmed that the odds ratio (OR) of developing loose IPC with PFM crown was 2.52 compared with metal crown (95% CI, 1.4 to 4.6; P = 0.002) table 2.

Table 1: Distribution of age, gender, experience , and specialty of the participants

Parameters	Frequency (%)	Total
Types of crown		
PFM	98 (65.3%)	150
Metal	52 (34.7%)	
Type of IPC		
Acceptable	194 (69.5%)	279
Loose	85 (30.5%)	
IPC associated with		
PFM	175 (62.7%)	279
Metal	104 (37.7%)	
Location of crowned teeth		
Maxillary 1st PM	11 (7.3%)	150
Maxillary 2nd PM	11 (7.3%)	
Maxillary 1st M	51 (34%)	
Maxillary 2nd M	10 (6.7%)	
Mandibular 1st PM	2 (1.4%)	
Mandibular 2nd PM	12 (8%)	
Mandibular 1st M	48 (32%)	
Mandibular 2nd M	5 (3.3%)	

PM=Premolar, M=Molar

Table 2: Association of proximal contact with type of crown, dental arch, surface of crown and gender.

Parameters	Proximal contacts presence		P value
	Acceptable	Loose	
Crown type			
Metal	83(79.8%)	21(20.2%)	0.004
PFM	111(63.4%)	64(36.6%)	
Dental arch			
Maxilla	102(65%)	55(35%)	0.025
Mandible	92(75.4%)	30(24.6%)	
Surfaces			
Mesial	105(75%)	35(25%)	0.047
Distal	89(64%)	50(36%)	
Gender			
Male	90 (46.4%)	104 (53.6%)	0.24
Female	46 (54.1%)	39 (45.9%)	

Table 3: Odds ratio of type of IPC with regards to Type of crown, Surface, Gender, Arch, Duration, Age and gender.

Variables		Crude Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)	p-value
Type of crown	Metal	1	**REF Value 1.0**	**0.002**
	PFM	2.27 (1.29-4)	2.52 (1.39-4.55)	
Surface of crown	Mesial	1	REF Value 1.0	.046
	Distal	1.685(1.006-2.824)	1.71(1.00-2.92)	
Arch	Maxilla	1	REF Value 1.0	.020
	Mandible	.545(.320-.928)	.522 (.298-.915)	
Duration of crown Service (Years)	1-3 Years	1	REF Value 1.0	
	4-6 Years	.665(.361-1.225)	.669 (.341-1.313)	.243
	7-9 Years	1.220(.482-3.088)	1.687 (.599-4.75)	.322
	10-12 years	1.601(.528-4.851)	3.419(.952-12.287)	.060
Age (years)	15-25 years	1	REF Value 1.0	
	26-35 years	2.04(.624-6.672)	1.599 (.460-5.563)	.460
	36-45 years	1.614(.540-4.818)	1.680 (.526-5.373)	.381
	46-55 years	1.153(.377-3.528)	1.073 (.334-5.457)	.906
	56-65 years	1.511(.452-5.052)	1.519 (.423-5.457)	.522
	66-75 Years	2.429(.531-11.107)	2.240 (.439-11.418)	.393
Gender	Male	1	REF Value 1.0	
	Female	.734(.440-1.224)	.676 (.372-1.227)	.198

DISCUSSION

Proximal contacts play an important role in success of crown. Loose/open IPC leads to food impaction which is quite annoying for patients and has drastically negative effect on oral health related quality of life. Besides that, food impaction provides a favorable environment to cariogenic bacteria and results in caries and gums inflammation. There are some factors which contribute to loose/open IPC such as poor shape of restoration, cracking of porcelain, adjacent tooth caries or mobility. But these contributing factors were kept in exclusion criteria so as to control confounders. The present study aimed at determining the effect of two types of crown material on IPC.

According to this study the association of type of crowns with type of IPC was found significant. The present study showed that over all prevalence of loose IPCs was 30.5%, while out of 30.5% of loose IPC, a high prevalence of loose IPCs was associated PFM crowns (75%) compare to metal crown (25%%) which is in accordance to study conducted by Akhtar Q[17].

In a comparison of the presence of IPC of crowns that were made in the maxilla and the mandible, a statically significant difference was found. The results of this study revealed that loose IPCs were most commonly seen in maxillary region (64.70%), then mandibular region (35.30%). These results are in agreement with Jung et al who conducted a clinical study on occurrence of food impaction and observed that it is more frequently observed in maxillary teeth (66%) than the mandible (34%)[19], but it is in contradiction with the study done by Nangarsekar, who stated that lower arch has increase loose IPC (65%) than upper (57%)[12]. These results are also not similar to the study of Almalki who stated that no significant difference was found between type of arch and type of IPC[13]. The reason for this contradiction maybe that mandibular molars often experience stronger mesial migration (a natural drift forward), which acts to close and tighten contact points, while maxillary teeth are more prone to loosening over time[20].

In a comparison of the presence of IPC of crowns that were found in the mesial and the distal surfaces, the study showed statistically significant differences. This study revealed that that there is increase prevalence of loose IPC on distal surface (58.82%) comparing to mesial surface (41.18%). These results are in agreement with the study of Durr-E-Sadaf[8] and Almalki A D[13].

This study results revealed statistically no signif-

icant association of gender and age with the type of IPC which is in agreement with the study conducted by Oh WS[21].

Logistic regression analysis was performed to examine the influence of age, gender, arch, duration, surface of crown and type of crown on type of IPC i.e. loose (table 3). There was a strong association between type of crown and type of IPC (OR 2.52, 95% CI 1.4–4.6, p=0.002). The p-value of 0.002 indicates that this influence is significant and chances of loose IPC increases by 2.52 times with PFM crown. The reason for increase chances of loose IPC with PFM crown may be that porcelain causes more wear than metal when it comes in contact with natural tooth. Because there is a continuous micro-movement between crown and natural tooth that causes wear of adjacent tooth surface[22].

Open/loose proximal contact can contribute to the periodontal pocket formation, gingival recession/ inflammation, calculus deposition, proximal carious lesions, food impaction, shifting of teeth (mesial drift), and faulty occlusion. The best possible proximal contacts during crown position positively affect the life span of the tooth. Factors like crowns with adjacent missing teeth, having caries in adjacent teeth, drifting, rotation or supra-eruption (of the adjacent tooth and the abutment tooth to be examined), chipping of proximal portion of porcelain, grade II or III mobility (of the adjacent and the abutment tooth to be examined), those who recently finished orthodontic treatment can contribute to the loose IPC. As these factors can act like confounders, so they were kept in exclusion criteria to minimize biases.

On the basis of results of this study, it is recommended that patients with prosthodontic crowns should be informed about the risk of loose IPC particularly when PFM crown is advised because of high prevalence. It is recommended that for better function metal crown should be advised for posterior teeth. For esthetic purpose only buccal and occlusal surface should be veneered with porcelain and proximal contact should be established in metal.

This study certainly has its own limitations. As the duration of follow up visit after cementation was different for most of the crowns. Also eating different types of food, clenching and bruxism was not considered in this study which can create bias. Thus, these factors and the cross-sectional design can limit the generalizability of the study. Thus, a well-designed randomized clinical study needs to be conducted to validate the results of this study.

CONCLUSION

Compare to metal, PFM crown has more chances of open/loose IPC.

The prevalence of loose IPC is more in maxilla than mandible.

Compare to mesial surface, distal surface of crown is more prone to have loose IPC.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	SUK, RJ, FA, SBA, FAK, AI
Acquisition, Analysis or Interpretation of Data:	SUK, RJ, FA, SBA, FAK, AI
Manuscript Writing & Approval:	SUK, RJ, FA, SBA, FAK, AI

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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