

# Predictors for Proximal Caries in Permanent First Molars: A Multiple Regression Analysis

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## ABSTRACT

**Aim:** The aim of this study was to determine the predictors of proximal decay in the permanent first molar.

**Materials and methods:** A cross-sectional study was conducted at the Department of Oral Medicine, Dow Dental College, Dow University of Health Sciences. A total of 171 patients presenting with 227 first molars were included. Calibrated examiners performed a detailed history and examination using a specialized form. The form recorded caries predictors and assigned a caries risk category based on the presence of these predictors. The statistical analysis was performed using the SPSS for windows version 17. A descriptive analysis was used to calculate the mean and proportions. Backward regression was carried out to evaluate the predictor for caries on mesial and distal surfaces at  $p \leq 0.05$ .

**Results:** The included 171 patients presented with a total of 227 decayed first molars and 412 decayed proximal surfaces. The mesial surface was found to be more affected by decay ( $0.92 \pm 0.85$ ). The caries risk profile explains 60%, and caries on the adjacent surface explains 90% of caries occurrence on the mesial surface. In the case of distal surfaces, the predictor which can cause caries significantly was caries risk only. The caries risk profile explains the 3% of caries occurrence on distal surfaces.

**Conclusion:** Our study identified caries on the adjacent tooth surface and the caries risk profile as significant predictors of future caries risk for the mesial surface of permanent molars.

**Clinical significance:** Predictors for mesial and distal surfaces of the permanent first molar may differ. Overall caries risk and status of adjacent teeth must be taken into account to predict future caries occurrence.

**Keywords:** Caries risk, Dental Caries, Permanent first molar, Predictor, Proximal surface, Regression analysis.

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## INTRODUCTION

In Pakistan, the prevalence of dental caries is rising. The previous studies conducted on the isolated Pakistani population reported high caries prevalence.<sup>1</sup> In addition to that, an increase in the mean decayed, missing, filled teeth (DMFT) score is observed as the age increases to 12 years (1.38), 15 years (1.94), and 35–44 years (8.02).<sup>2</sup> The evidence suggests that as the prevalence of dental caries increases, the number of carious surfaces will also increase.<sup>3</sup> Moreover, evidence also shows that teeth in the oral cavity are exposed to the same caries causing risk factors. However, some teeth and surfaces have been reported to be more caries prone.<sup>4</sup> The permanent first molar due to its early eruption and the posterior location is the most caries prone and the most treated tooth in dentistry.<sup>4,5</sup>

A different caries risk has been associated with its different surfaces. A study reported a higher caries incidence for the buccal and occlusal surfaces as compared to proximal surfaces.<sup>4</sup> The proximal surfaces of first molars have attracted a lot of attention historically.<sup>6,7</sup> The site-specific data show a variation in caries incidence for proximal surfaces of the permanent first molar. On the one hand, Lith reported an increased incidence of dental caries in mesial surfaces of the first molar.<sup>8</sup> On the other hand, Stenlund et al. found more caries incidence on distal surfaces of the same tooth.<sup>9</sup>

In addition to that, Hopcraft reported a possible association of age with the site of a tooth, occlusal caries been more common in young while proximal caries was observed more in older subjects.<sup>5</sup> Previous literature reports several causative factors for proximal carious lesions such as caries on an adjacent surface, proximal composite restorations, open contacts, overhanging margins of adjacent restorations, and open margins.<sup>10–12</sup> However, no studies

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have been previously carried out on the Pakistani population to identify the predictors of proximal caries in permanent first molars.<sup>13–18</sup> Therefore, the objective of this study is to determine the predictors of proximal carious lesions in permanent first molars.

## MATERIALS AND METHODS

A 6-month cross-sectional study was conducted from January to June 2018. The sample was drawn from the patients reporting

at the Department of Oral Medicine, Dow Dental College, Dow University of Health Sciences. The project was approved by the Institutional Ethical Board (IRB 585/DUHS/Approval/2015/110) and all human participation was according to the Helsinki declaration.<sup>19</sup> A sample size of 224 was calculated using the Open Epi version 2 (open source calculator SS-proper). We used a frequency of class II decay reported in a previous article (62% at 95% CI, 80% power) for the calculation.<sup>20</sup>

Our inclusion criteria were as follows: patients presenting with proximal decay in any of the permanent first molars, permanent dentitions, and of either gender. While we excluded patients that presented with a secondary proximal decay in permanent molars. All participation was voluntary and participants were asked to provide a written consent. Included participants underwent a comprehensive history and examination based on a specific examination form published previously.<sup>21</sup> Briefly, the form was composed of the following parts. The first part recorded the basic data. The second part was based on an interview about oral hygiene practices and dietary habits. In the third part, specific risk factors like medical history, oral hygiene, carious lesions, use of fluoride, consumption of carbohydrates, and salivary flow were recorded. A caries risk assessment criterion was used to assign a risk category to the participant either low, moderate, or high risk.<sup>22</sup> This was followed by a comprehensive intraoral and radiographic examination.

**Intraoral Examination**

All included patients underwent a comprehensive examination. The decayed surfaces were measured according to WHO criteria.<sup>23</sup> We specifically looked at the pattern of proximal decay on first molars and status of adjacent surfaces, in particular, open contacts, the status of adjacent restoration with a special emphasis on margins of restorations and caries of adjacent surfaces was recorded. The periodontal examination included recording of simplified debris index, simplified calculus index, and gingival index for the respective first molars.<sup>24,25</sup> All examinations were performed by two calibrated senior residents of the Department of Operative Dentistry. The calibration process for each examination involved examining a set of each condition with a consultant with 15 years of experience. All examinations were performed at the Department of Oral Medicine.

**Radiographic Examination**

Bitewing radiographs were performed on all patients. The radiographs were viewed under standard conditions. An illuminator was used to view and score selected radiographs. The same calibrated examiners made all the readings. Following were recorded from each radiograph: caries on the proximal surface of the permanent first molar, any restoration or fixed prosthesis on the adjacent surface or teeth, and its quality in terms of margins. Similar calibrations were performed as in the previous section. The interexaminer reliability was calculated between the two observers using Cohen’s kappa. There was a good agreement between the two examiners,  $\kappa = 0.72, p < 0.001$ .

**Data Analysis**

A specially designed proforma was used to collect the data. Data analysis was performed with the SPSS version 17 for Windows. The level of significance was set at less than 0.05. A descriptive analysis was conducted to calculate the mean and proportions. Backward regression was carried out to evaluate the predictor for caries on mesial and distal surfaces.

**RESULTS**

A total of 171 participants were fit into the inclusion criteria, a majority (98.8%) of them were from urban location (Table 1). The mean age of participants was  $31.66 \pm 11.3$  years. The majority of participants were females (59.1%). The participants with malocclusion were (47.4%), removable appliances on adjacent tooth surfaces (1.8%), restoration on adjacent tooth surfaces (2.9%), fixed prosthesis on the adjacent tooth surface (0.6%), missing adjacent tooth (5.8%), and caries on the adjacent tooth surface (51.5%) (Table 1). Majority of teeth were lower first permanent molars (52.8%). Majority of participants were with high caries risk (49.7%) (Table 1).

The mean of decayed mesial surfaces ( $0.92 \pm 0.85$ ) was more than the mean of decayed distal surfaces ( $0.73 \pm 0.81$ ) (Table 2). For mesial surfaces, significant caries predictors were caries risk and caries on the adjacent tooth surface. The caries risk profile explains 60%, and the caries on the adjacent surface explains 90% of caries occurrence on the mesial surface (Tables 3 and 4). In the case of distal surfaces, the predictor which can cause caries was only caries risk. The caries risk profile explains the 3% of caries occurrence on distal surfaces (Table 5).

**DISCUSSION**

It is necessary to understand the predictors of proximal surface caries in the local population. This is the first local study which

**Table 1:** Proportion of participants

Variables	N (%)
Gender	
Male	70 (40.9)
Female	101 (59.1)
Residence	
Rural	2 (1.2)
Urban	169 (98.8)
Malocclusion	
Yes	81 (47.4)
No	90 (52.6)
Removable appliances on adjacent tooth surfaces	
Yes	8 (4.7)
No	163 (95.3)
Restoration on adjacent tooth surfaces	
Yes	5 (2.9)
No	166 (97.1)
Fixed prosthesis on adjacent tooth surface	
Yes	1 (0.6)
No	170 (99.6)
Caries risk	
Low	9 (5.3)
Moderate	77 (45.0)
High	85 (49.7)
Caries on adjacent surface	
Yes	88 (51.5)
No	83 (48.6)
Missing adjacent tooth	
Yes	10 (5.8)
No	161 (94.2)

**Table 2:** Proportion of permanent molar and surfaces

Variables	N (%)
Teeth	
Upper 6	107 (47.2)
Lower 6	120 (52.8)
Total	227 (100)
Tooth surfaces	
Upper 6 mesial	144 (34.9)
Upper 6 distal	66 (16)
Lower 6 mesial	99 (24)
Lower 6 distal	103 (25.1)
Total	412 (100)
Decayed surfaces	Mean ± SD
Mesial	0.92 ± 0.85
Distal	0.73 ± 0.81

**Table 3:** Variables in linear regression analysis

Variables	Mesial surface	Distal surface
	p value	p value
Malocclusion	0.60	0.72
Removable appliances on adjacent surfaces	0.75	0.14
Restoration on adjacent surfaces	0.74	0.03
Caries risk	0.03	0.007
Adjacent fixed prosthesis	0.59	0.43
Caries on adjacent surface	0.001	0.64
Missing adjacent tooth	0.06	0.10

**Table 4:** Predictors for caries on mesial surface of first permanent molar

Variables	p value	R <sup>2</sup>
Caries on adjacent surface	0.001	0.91
Caries risk	0.001	0.61

R<sup>2</sup>, Regression analysis

**Table 5:** Predictors for caries on the distal surface of the permanent first molar

Variables	p value	R <sup>2</sup>
Caries risk	0.01	0.03

R<sup>2</sup>, Regression analysis

provides data regarding the caries predictors for specific tooth sites due to which the comparison with local and national data is not possible.

In our study, the higher mean score of decayed mesial surfaces was observed as compared with the decayed distal surfaces. Lith et al. reported a similar finding indicating that the mesial surface of the first molar is more caries susceptible.<sup>8</sup> As mentioned above that the prevalence of dental caries is increasing in Pakistan, and the working rule for dental caries is that as the prevalence of dental caries increases, caries in the least susceptible proximal surfaces also increases.<sup>3</sup>

A cross-sectional study conducted on the Pakistani population reported previous caries experience as a predictor of dental caries in the Pakistani population.<sup>26</sup> Similarly, in our study, caries on the adjacent tooth surface explain 90% of caries occurrence on mesial surfaces (Table 4).

In this study, the dental caries on the adjacent tooth surface was found as a significant predictor of dental caries at the mesial surface of a first permanent molar. However, for the distal surface, it was found to be insignificant (Tables 4 and 5). Owing to the unique nature of our study, we are unable to compare this result with the published literature. However, this effect may be due to the exposure of the mesial surface of the first molars to the carious deciduous second molar. It has been reported that the caries experience in deciduous molars may influence caries susceptibility on the adjacent permanent tooth surface.<sup>27</sup> Another reason for low caries occurrence on the distal surface may be due to the late formation of its contact with the second molar. Hence, the distal surface remains self-cleansable for longer.<sup>28</sup>

Very few patients presented with fixed prosthesis. This can be explained by the fact that a majority of the patients belonged to the low socioeconomic status group. The presence of a fixed prosthesis on the surface adjacent to a proximal carious lesion might indicate a faulty restoration allowing food accumulation.<sup>12</sup> A majority of patients were categorized as high risk for future caries followed by a moderate risk. The caries risk assessment was based on various extra and intraoral indicators as described above. It is, therefore, apparent that proximal decay in the permanent first molar may be indicative of severe risk for future caries.

We report a limited sample size and using only the permanent first molars as our limitations. Another limitation is the cross-sectional design of the study. A longitudinal study with a follow-up may determine a relationship of the predictors with proximal decay. We recommend future studies with a larger sample size and use of different caries risk assessment tools.

## CONCLUSION

Our study identified caries on the adjacent tooth surface and caries risk profile as significant predictors of future caries risk for the mesial surface of permanent molars. Dental caries was found more frequently on the mesial surface of the permanent first molar.

## CLINICAL SIGNIFICANCE

Predictors for mesial and distal surfaces of the permanent first molar may differ. Overall, caries risk and status of adjacent teeth must be taken into account to predict future caries occurrence.

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