

Evaluation Distal Caries of the Second Molars in the Presence of Third Molars among Saudi Patients

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ABSTRACT

Objectives: To evaluate the prevalence of distal caries in second permanent molars in the presence of third molar among patients attending university dental clinics in Riyadh City, Kingdom of Saudi Arabia. **Materials and Methods:** Clinical and radiographic data (orthopantomographs and right and left bite wings) from 313 patients attending Riyadh Elm University dental clinics, department of oral diagnosis were collected and analyzed for the presence of third molars and caries on the distal surface of the second molar. Descriptive statistics of frequency distribution, mean and standard deviation, and binary logistic regression analysis were applied to assess the association between distal surface caries on second molars and impaction status of the teeth. **Results:** The mean decayed, missing, and filled teeth score of the study participants was found to be very high, that is, 23. The prevalence of caries affecting the distal aspect of the second molar was 48.6% ($n = 609$) in the population. The prevalence of distal caries was significantly high in patients with fully erupted wisdom teeth followed by vertical, horizontal, and mesial impacted third molars ($P < 0.05$). Wisdom teeth with mesioangular, vertical, and horizontal impactions showed significant association with distal caries of second molars below the contact point, whereas, fully erupted and vertically impacted wisdom teeth showed significant association with distal surface caries of second molars above contact point. Similarly, vertically impacted wisdom teeth were found to have significant association with caries of distal surface of second molars on noncontact areas ($P < 0.05$). **Conclusion:** This study showed that the distal surface of the second molars is at risk of caries in the presence of third molars. However, this risk depends on eruption status, type of angulation, and contact between third and second molars. All the preventive measures should be taken to avoid caries on distal surface of second molar.

KEYWORDS: Distal caries, impacted third molar, second mandibular molar

INTRODUCTION

Third molars commonly start appearing in the mouth between the ages of 17 and 24 years, even though there is a wide difference in eruption times. Some third molars may still erupt even after 50 years of life.^[1,2] Third molars may erupt into the right dental position of the arch and become functional. On the contrary, third molar erupts in a nonfunctional or partly functional locations of the jaws, and are known as impacted third molars. Any of the third molar can get affected by impaction;

however, mandibular third molars are more likely to get impacted. Occurrence of third molar impaction is related to various factors such as age, sex, ethnicity, facial skeleton, and genetics.^[3] Impaction of permanent teeth is attributed to the systemic and local factors.

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Systemic causes range from endocrine deficiencies such as hypothyroidism and hypopituitarism, cleidocranial dysplasia to Down's syndrome.^[4] In general, local factors include arch-length-tooth material deficiency, presence of extra or supernumerary teeth, odontogenic tumors, over retention of deciduous teeth, cleft lip and palate, and malposed tooth germs.^[5]

Many studies conducted in different parts of the world have reported a variable prevalence of third molar impaction, ranging from 16.7% to 68.6%.^[6-10] Recent study highlighted the factors that affect the severity of permanent tooth impaction. Study revealed that more delay in the treatment of impacted tooth, being female, microdontia of existing lateral incisors, and over retained deciduous canine might be related to the severe position of the impacted tooth.^[11] Numerous approaches have been designed to classify impaction based on the level of impaction, the angulation of third molar, and the association to anterior border of the ramus of the mandible.^[12]

Prevalence of third molar impaction is high in Saudi Arabian population. Impacted third molars were common in the mandible than that in the maxilla. Mesioangular impaction of the third molar is common in mandible, whereas vertical impaction of the third molars is high in the maxilla. In addition, significantly low percentage of pathosis related to the impacted third molar was observed. When prevalence of the impacted third molars was compared between male and female Saudi adults, no significant differences were observed.^[13-15] Presence of impacted third molar is associated with pathologies such as cysts,^[16,17] pericoronitis,^[18] periodontal diseases,^[19] and caries.^[20]

Several published reports have suggested development of dental caries in teeth that are placed next to the impacted third molars.^[9,21,22] Caries affects the disto-cervical area of the second molar, especially in cases of mesioangular impaction of mandibular third molar.^[20,23,24] It is hard to identify the dental decay on the second molars adjacent to the impacted third molars due to the difficulty involved in visual examination of the distal surface of the second molar surface in the presence of impacted third molars.

A retrospective radiographic study from Saudi Arabia reported distal cervical caries in second molars was 39% with impacted mandibular third molars.^[9]

However, none of the past studies have considered impacted maxillary third molars and the presence of caries on distal surface of adjacent second molars. Many studies evaluated dental caries on the distal surface of lower second molar in the presence of impacted third

molars. However, a scant information is available about the distal surface caries of second molars in the presence of both maxillary and mandibular third molars. There is a need to determine the extent and the severity of distal caries of maxillary and mandibular second molars in the presence of impacted third molars. This study helps to make appropriate decision concerning the prevention loss of permanent second molars. It further strengthens the evidence pertaining to the decision about the extraction of the third molars.

Hence, the purpose of this clinico-radiographic study was to evaluate the prevalence of distal caries in maxillary and mandibular second permanent molars in the presence of impacted third molars among patients attending university dental clinics in Riyadh City, Kingdom of Saudi Arabia.

MATERIAL AND METHODS

ETHICAL APPROVAL

Study proposal was submitted and formal approval was obtained from the research center of Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia. Study was registered with number FPGRP/43738011/212. Institutional review board approved the study IRB No. RC/IRB/2018/981.

STUDY DESIGN AND SETTING

This was a cross-sectional, clinico-radiographic study among the patients attending dental clinics in Munisiya campus of Riyadh Elm University. Patients attending screening clinics were invited to participate in the study. Data were collected over 4 months from April 2018 to July 2018.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria consisted of patients aged ≥ 25 years, Saudi national, patients having fully erupted maxillary and mandibular second permanent molars adjacent to the third molars, patients willing to participate in the study and ready to give informed consent, and patients willing to undergo radiographs (having recent digital radiographs within the clinical computer system).

Exclusion criteria consisted of patients aged < 25 years, expatriates, patients having any of the missing maxillary or mandibular second or third molars, patients having mobile second or third molars, patients not willing to participate in the study, and patients not willing to undergo radiographs.

SAMPLE SIZE CALCULATION

Sample size was calculated based on the following formula:

$$n = \frac{z^2 p(1-P)}{d^2}$$

where, n = required sample size, $z = z$ statistic for a level of confidence, P = expected prevalence or proportion of 28.6%, $P = 0.286$ distal caries, and d = precision (in proportion of one; if 5%, $d = 0.05$). Z statistic (z) for the level of confidence of 95%, z value is 1.96. The sample size achieved was 313 patients.

DATA COLLECTION

Single examiner recorded the demographic, clinical, and radiographic information.

CLINICAL ORAL EXAMINATION

All the clinical oral examinations were performed by a single postgraduate student from Advanced General Dentistry Department, College of Dentistry, Riyadh Elm University. Patients were selected from the screening dental clinics in Munisiya campus. Examination of the oral cavity was performed by using (oral diagnostic kit) mouth mirror, the World Health Organization (WHO) probe, and air syringe while the patient was seated in a dental chair with artificial illumination. Patients were examined mainly to identify the presence of second and third permanent molars within the oral cavity. Later on, decayed, missing, and filled teeth (DMFT) were recorded based on the criteria described by WHO in 1998.

RADIOGRAPHS

Radiographic evaluation of the posterior mandibular and maxillary teeth was performed by taking bilateral digital bitewing radiographs by using intraoral X-ray device (Fona SRL, Assago, Italy) and panoramic radiographs taken by using Sirona Imaging System (Bensheim, Germany) by considering standard exposure time. A total of 626 bitewing radiographs and 313 panoramic radiographs were assessed by using Sidexis software system in the computer. Before the start of the study, investigator underwent calibration exercise in assessing radiographs to improve intra-examiner reliability in the diagnosis of proximal carious lesions. In cases of availability of the recent digital bitewings and panoramic radiographs, no attempt was made to repeat the radiographs.

Caries experience, angulation of the third molars based on their long axis and angulation with reference to the longitudinal axis of the nearby second molar, impacted third molar's eruption condition, molar to molar contact, and presence and absence of dental caries in upper and lower second molars were noted. Furthermore, individual DMFT score was calculated by addition of decayed, missing, and filled components of the index.

STATISTICAL ANALYSIS

All the data were entered and analyzed by using the Statistical Package for the Social Sciences (SPSS)

software, version 22.0. Frequency distribution, cross tabulations, and chi-square test were applied to the data. Binary logistic regression analysis was performed to predict the association of distal surface caries of second molars above and below the contact point in the presence of fully or partially impacted third molars. Level of significance was set at $P < 0.05$ for all the statistical purposes.

RESULTS

A total of 313 patients (male = 191, female = 122) having mean age of 32 ± 11.2 years participated in the study. More than half (160, 51.1%) of the study participants were in the age group of 20–29 years. More than half (175, 55.9%) of the patients were married and 138 (44.1%) of the patients were single. Majority of the participants had no medical problems (205, 65.5%). Chi-square test showed that the presence of medical problems were associated significantly with the occurrence of distal surface caries above the contact area of the second molar teeth ($P = 0.14$), as shown in Table 1.

Of the 1252 third molars examined, 881 (70.4%) had normal complete eruption and 371 (29.6%) were impacted. Vertical impaction (171, 13.71) was the most common type of impaction found among the study sample followed by horizontal (86, 6.9%), mesioangular (71, 5.7%), and distoangular (43, 3.4%) type of impactions. Prevalence of distal surface caries of second molar was found to be 609 (48.6%), as shown in Figure 1.

Study sample showed mean and standard deviation (SD) scores of decayed (11.37 ± 6.45), missing (2.52 ± 3.2), filled teeth (9.09 ± 5.52) with overall DMFT scores (23 ± 5.05) [Figure 2].

Table 2 shows the distribution of the impacted third molars in upper and lower jaws and distal surface caries of second molars. Mesioangular impaction is commonly observed with mandibular third molars on right and sides. Distoangular impaction is commonly observed with maxillary right third molars and vertical impaction is common in maxillary left third molars. Mandibular right second molar showed high caries rate on distal surfaces below the contact area (97, 31%), above contact (61, 19.5%), and also in no contact areas (28, 8.9%).

Nearly 180 (29.6%) impacted third molars and 429 (70.4%) completely erupted third molars showed an association with distal surface caries of second molars without any statistically significant differences ($\chi^2 = 0.003$, $df = 1$, $P = 0.954$). Presence of mesioangular impaction was significantly

Table 1: Relationship between demographic variables and occurrence of distal surface caries of second molar

Variables		Below				Above				No contact			
		No caries		Cariou		No caries		Cariou		No caries		Cariou	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Age (years)	20–29	127	50.8	33	52.4	132	50.8	28	52.8	150	50.5	10	62.5
	30–39	70	28.0	16	25.4	72	27.7	14	26.4	83	27.9	3	18.8
	40–49	34	13.6	9	14.3	36	13.8	7	13.2	40	13.5	3	18.8
	Above 50	19	7.6	5	7.9	20	7.7	4	7.5	24	8.1	0	0.0
	<i>P</i>	0.982				0.994				0.476			
Gender	Female	102	40.8	20	31.7	103	39.6	19	35.8	117	39.4	5	31.3
	Male	148	59.2	43	68.3	157	60.4	34	64.2	180	60.6	11	68.8
	<i>P</i>	0.188				0.608				0.515			
Marital status	Married	144	57.6	31	49.2	145	55.8	30	56.6	168	56.6	7	43.8
	Single	106	42.4	32	50.8	115	44.2	23	43.4	129	43.4	9	56.3
	<i>P</i>	0.230				0.911				0.315			
Medical Problem	No	161	64.4	44	69.8	178	68.5	27	50.9	194	65.3	11	68.8
	Yes	89	35.6	19	30.2	82	31.5	26	49.1	103	34.7	5	31.3
	<i>P</i>	0.417				0.014*				0.779			

**P* < 0.05 (chi-square test)

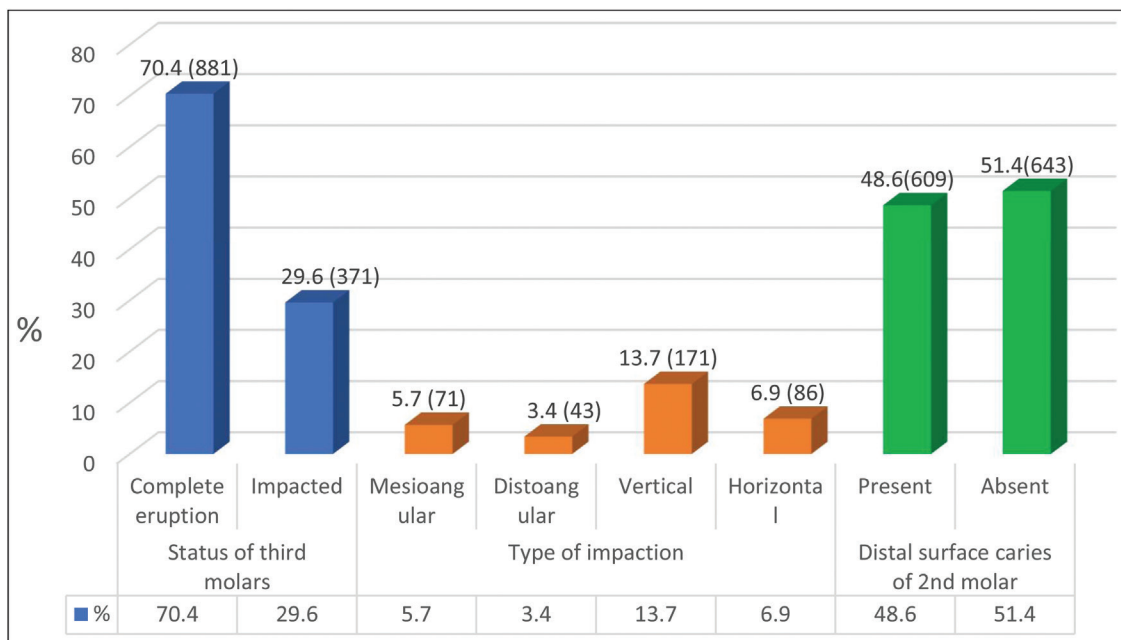


Figure 1: Status of third molars, type of impaction, and distal surface caries of second molar

associated with distal surface caries of the second molar ($\chi^2 = 4.14$, *df* = 1, *P* = 0.042). As well as vertical impaction ($\chi^2 = 5.226$, *df* = 1, *P* = 0.022) and horizontal impactions ($\chi^2 = 16.583$, *df* = 1, *P* = 0.000) of the third molars were significantly associated with the occurrence of distal surface caries on the second molars. On the contrary, distoangular impactions did not show any significant association with distal surface caries of the second molars ($\chi^2 = 0.016$, *df* = 1, *P* = 0.901) [Table 3].

Normally erupted third molars showed significant association with distal surface caries of second molars

below the contact points (*P* = 0.000) and above the contact points (*P* = 0.000) compared to impacted third molars. Mesioangular impaction, vertical impaction, and horizontal impaction were found to be significantly associated with distal surface caries of the second molars below the contact point (*P* = 0.000). Similarly, only vertical impacted third molars showed significant association with distal surface caries of the second molars above the contact point (*P* = 0.006) and no contact area (*P* = 0.010) [Table 4].

Binary logistic regression analysis indicated that fully erupted third molars (odds ratio [OR] = 31.59, 95%

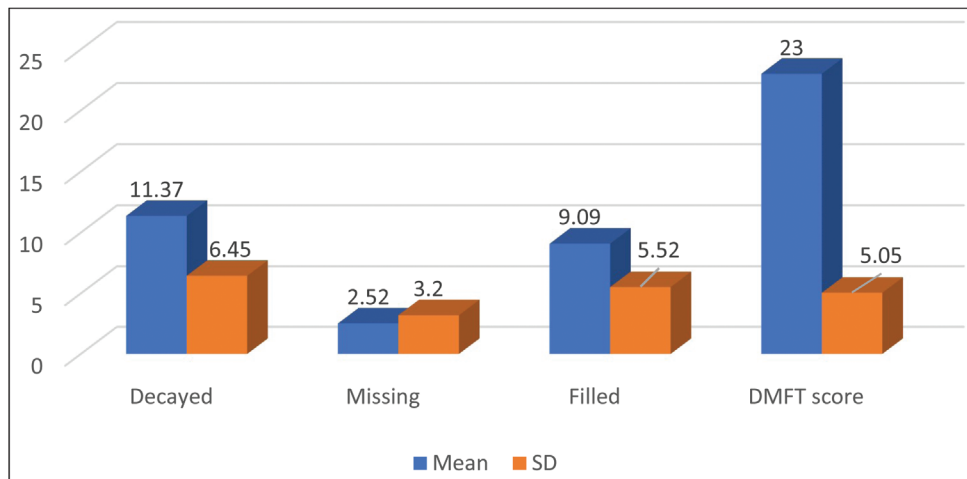


Figure 2: Mean decayed, missing, filled teeth score

Table 2: Partial eruption of third molars and distal surface caries of second molar

Type of partial eruption of third molars Side	Distal caries status of second molars			
	MA	DA	V	H
Max right	7 (2.2%)	21 (6.7%)	47 (15.0%)	5 (1.6%)
Max left	1 (0.3%)	18 (5.8%)	56 (17.9%)	9 (2.9%)
Mand left	30 (9.6%)	2 (0.6%)	35 (11.2%)	33 (10.5%)
Mand right	33 (10.5%)	2 (0.6%)	33 (10.5%)	39 (12.5%)

Max = maxillar, Mand = mandibular, MA = mesioangular, DA = distoangular, V = vertical, H = horizontal, BC = below contact, AC = above contact, NC = no contact

Table 3: Types of impacted third molar and distal surface of caries of the second molar

Type of impaction		Caries absent		Caries present		χ^2	df	P
		n	%	N	%			
Third molar status	Impacted	191	29.7%	180	29.6%	0.003	1	0.954
	Erupted	452	70.3%	429	70.4%			
Mesioangular	Absent	629	95.6%	552	92.9%	4.140	1	0.042*
	Present	29	4.4%	42	7.1%			
Distoangular	Absent	635	96.5%	574	96.6%	0.016	1	0.901
	Present	23	3.5%	20	3.4%			
Vertical	Absent	582	88.4%	499	84.0%	5.226	1	0.022*
	Present	76	11.6%	95	16.0%			
Horizontal	Absent	631	95.9%	535	90.1%	16.583	1	0.000*
	Present	27	4.1%	59	9.9%			

χ^2 = chi-square, df = degrees of freedom

*Chi-square statistic is significant at the 0.05 level

confidence interval [CI] = 4.20–237.59, $P = 0.001$), mesioangular (OR = 61.72, 95% CI = 5.00–761.66, $P = 0.001$), distoangular (OR = 13.85, 95% CI = 1.28–150.06, $P = 0.031$), vertical (OR = 32.33, 95% CI = 3.80–275.29, $P = 0.001$), and horizontal (OR = 28.31, 95% CI = 1.32–608.77, $P = 0.033$) impacted third molars more likely to show distal surface of caries below the contact area of the tooth. However, DMFT score (OR = 1.10, 95% CI = 1.01–1.19, $P = 0.023$), fully erupted third molars (OR = 37.21, 95% CI = 4.92–281.49, $P = 0.000$), and distoangular impaction of the third molars (OR = 21.70, 95% CI = 2.10–224.71, $P = 0.010$) were associated with increased odds of having

caries of the distal surface of the second molar above the contact area. In general, the presence of underlying medical condition (OR = 0.50, 95% CI = 0.26–0.95, $P = 0.034$) and fully erupted third molars were more likely to be associated with the increased risk of distal surface caries of the second molars in the presence of the third molars (OR = 3.62, 95% CI = 1.99–6.59, $P = 0.000$) [Table 5].

DISCUSSION

Third molars are generally the last teeth to erupt within the oral cavity. Mainly, they appear between the ages of 18 and 21 years.^[25] Hence, most of the participants

Table 4: Relationship between impaction status and occurrence of distal caries on second molars at different contact points

Status of third molars		Below contact		P	Above contact		P	No contact		P
		Caries (%)			Caries (%)			Caries (%)		
		Absent	Present		Absent	Present		Absent	Present	
Eruption status	Impacted	25.9	40.8	0.000*	32.8	14.4	0.000*	29.6	29.9	0.962
	Normal erupted	74.1	59.2*		67.2	85.6*		70.4	70.1	
Mesioangular impaction	Absent	96.5	88.0	0.000*	94.0	95.8	0.293	94.3	94.8	0.852
	Present	3.5	12.0		6.0	4.2		5.7	5.2	
Distoangular impaction	Absent	96.4	97.2	0.508	96.7	95.8	0.516	96.7	94.8	0.381
	Present	3.6	2.8		3.3	4.2		3.3	5.2	
Vertical impaction	Absent	88.4	80.4	0.000*	85.1	92.1	0.006*	87.0	76.6	0.010*
	Present	11.6	19.6		14.9	7.9		13.0	23.4	
Horizontal impaction	Absent	95.9	84.8	0.000*	92.8	94.9	0.256	93.3	90.9	0.426
	Present	4.1	15.2		7.2	5.1		6.7	9.1	

*P < 0.05 (chi-square test)

Table 5: Binary logistic regression analysis of distal surface caries of second molars in presence of third molars

Variables	Below contacts area			Above contact area			Combined					
	OR	95% CI		OR	95% CI		OR	95% CI		P		
		LB	UB		LB	UB		LB	UB			
Age	1.02	0.98	1.07	0.331	0.96	0.91	1.01	0.127	1.01	0.98	1.04	0.514
Gender F/M	1.39	0.73	2.65	0.311	0.67	0.33	1.37	0.275	1.12	0.68	1.84	0.656
Marital status*	1.32	0.57	3.10	0.519	0.85	0.33	2.16	0.725	1.44	0.74	2.81	0.286
Medical Problem*	0.64	0.27	1.52	0.314	2.16	0.91	5.14	0.081	0.50	0.26	0.95	0.034
DMFT score	1.03	0.96	1.10	0.388	1.10	1.01	1.19	0.023	1.02	0.97	1.08	0.365
Fully eruption*	31.59	4.20	237.59	0.001	37.21	4.92	281.49	0.000	3.62	1.99	6.59	0.000
Mesioangular*	61.72	5.00	761.66	0.001	0.00	0.00	0.00	0.999	0.28	0.03	2.47	0.250
Distoangular*	13.85	1.28	150.06	0.031	21.70	2.10	224.71	0.010	2.26	0.78	6.52	0.132
Vertical*	32.33	3.80	275.29	0.001	4.84	0.40	58.42	0.214	2.10	0.92	4.78	0.078
Horizontal*	28.31	1.32	608.77	0.033	0.00	0.00	0.00	0.999	1.69	0.24	12.16	0.600

OR = odds ratio, CI = confidence interval, LB = lower bound, UB = upper bound

*Significance value is set to be P < 0.05

in this study were in 25–34 years age group, which is almost similar to the other reported study.^[8] Higher proportions of impacted third molars among males reported in this study are similar to the other previous studies^[9,15] and contrary to the study reported by Kumar *et al.*^[8] among the Eritrean population.

Dental caries was the most common lesion observed in panoramic radiographs of second molars adjacent to the third molars.^[26] Distal surface caries in the second molar is considered as a late complication of third molar eruption or impaction. This could be suggestive of long-term patient's failure to effectively maintain oral hygiene in this area. The prevalence of distal second molar caries associated with partially or completely impacted third molar reported to vary from 1% to 47%.^[27-30] In general, our study reported 48.6% prevalence in distal surface caries of second molar in the presence of third molars. Moreover, distal caries of the second molars was higher adjacent to the fully

erupted third molars rather than the impacted third molars.

Maxillary right and left third molars were commonly involved in vertical impaction, whereas vertical and horizontal impactions were commonly observed with mandibular third molars as shown in this study. In general, vertical impaction of the third molar was the most common type of impaction followed by other patterns. This finding is in line with the study reported by Al-Dajani *et al.*,^[15] in Saudi Arabia. Previous studies have reported that mesioangular and horizontally placed third molars are more likely to be linked with caries development in the adjacent second molars.^[31,32] These findings are in line with our study in which significant relationship of mesioangular, horizontal, and vertical impactions with the distal surface caries of the second molar was found.

However, in our study, distoangular impaction did not show any significant association with incidence of distal

surface caries of the second molar. In fact, the distal carious lesions of the second molars were found to be least in the presence of the distoangular impactions. Hence, the previous study reported distoangular impaction as a protective factor for dental caries.^[33]

Some authors argued that the dental caries is strongly and significantly related to the age, and caries is specific to the second molar not affected by the presence of third molars. This finding may be partly true because caries in second molar may be the effect of long-standing partially erupted or impacted status of third molars.^[34] In this study, caries of second molars was higher in the presence of fully erupted third molars rather than the impacted third molars suggesting possible role of age-related dental caries of the second molars.

Distal caries of second molars is unique in that it is observed at the cemento-enamel junction and is also called as distal-cervical caries, a type of root surface caries.^[29] Distal root surface caries and proximal surface caries were found to affect distal surface of the second molar. When mesial cusp of a mesioangular impacted third molar contacts above the cemento-enamel junction, resulting in distal proximal caries lesion of second molar. On the contrary, if the contact is made below the cemento-enamel junction, it resulted in root surface caries of the second molar.

Notched enamel surface below the contact point in radiographs is the hallmark of proximal caries, whereas, radiographically root surface caries is visible between the cemento-enamel junction and the free gingival margin, loss of attachment, and bone loss areas, and involves wider areas. Hence, this offers possible narrative of significantly higher proportion of second molars showing dental caries in the presence of third molars placed below the cemento-enamel junction.^[31] In our study, mesioangular impaction, vertical impaction, and horizontal impaction were significantly associated with distal surface caries of the second molars below the contact point and vertical impacted third molars showed significant association with distal caries of the second molars above the contact point. This is suggestive of third molar contact with second molars in causing proximal or root surface caries.

In this study, highest OR was observed with the mesioangular impaction of the third molar with increased risk of distal surface caries of the second molars below the contact area. Although fully erupted third molars are likely to be associated with the odds of having increased risk of distal surface caries above the contact area and in general, distal surface caries of the second molars. However, age, gender, and marital status did not affect significantly the risk of distal surface caries of the second molars in the presence of

third molars. Some authors viewed that in general, if caries susceptibility is higher, then it is linked to the increased risk of distal surface caries of the second molars.^[33] In our study, the mean DMFT score was remarkably higher without any significant differences between genders. The DMFT index scores offer largely a summary of the current and past caries experience of a patient. Also, it can be used for the caries risk assessment of the patients to predict future caries risk. Conventionally, DMFT index showed good predictive powers in the fully erupted dentition. However, DMFT cannot be considered a dependable predictor of distal surface caries adjacent to the impacted third molars.^[31]

A confounder is an extraneous variable the presence of which affects the variables being studied so that the results do not reflect the actual relationship between the variables under study. These confounding variables can be controlled by randomization, restriction, and matching at the time of study design. Statistical models such as regression models are used to eliminate the effects of confounders after the data are collected, when other methods were impractical.^[35] Regression analysis was performed to control the confounders.

One of the major limitations of the study is that it used the patients attending dental clinics from one place rather than different areas. Second, these patients may not represent the wider population within the Riyadh City, thereby limiting the generalizability of the results. Future studies involving larger sample size covering wide area of population with a greater number of variables are required to validate the conclusion of this study.

CONCLUSION

This study revealed that the eruption condition, angulation of the impacted third molars, and the tooth contact between third molars and distal surface of the second molar are indicators of the likelihood of caries on distal surface of the second molar. Moreover, mere presence of the fully erupted third molar could pose risk for the development of distal caries on second molar. Hence, regular monitoring of the distal surface of second molar should be performed by taking periodic bitewings and required care to avoid any future complications. DMFT score of the individual patients should be used carefully to predict the distal surface caries of the second molars.

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Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

- Ventä I, Schou S. Accuracy of the third molar eruption predictor in predicting eruption. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001;91:638-42.
- Shaweesh AI. Timing of clinical eruption of third molars in a Jordanian population. *Arch Oral Biol* 2016;72:157-63.
- Trakinienė G, Šidlauskas A, Trakinis T, Andriuškevičiūtė I, Šalomskienė L. The impact of genetics and environmental factors on the position of the upper third molars. *J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg* 2018;76:2271-9.
- Masood F, Benavides E. Alterations in tooth structure and associated systemic conditions. *Radiol Clin North Am* 2018;56:125-40.
- Kang F, Huang C, Sah MK, Jiang B. Effect of eruption status of the mandibular third molar on distal caries in the adjacent second molar. *J Oral Maxillofac Surg* 2016;74:684-92.
- Carter K, Worthington S. Predictors of third molar impaction: A systematic review and meta-analysis. *J Dent Res* 2016;95:267-76.
- Saberi EA, Ebrahimipour S. Evaluation of developmental dental anomalies in digital panoramic radiographs in southeast Iranian population. *J Int Soc Prev Community Dent* 2016;6:291-5.
- Kumar VR, Yadav P, Kahsu E, Girkar F, Chakraborty R. Prevalence and pattern of mandibular third molar impaction in Eritrean population: A retrospective study. *J Contemp Dent Pract* 2017;18:100-6.
- Syed KB, Alshahrani FS, Alabsi WS, Alqahtani ZA, Hameed MS, Mustafa AB, *et al.* Prevalence of distal caries in mandibular second molar due to impacted third molar. *J Clin Diagn Res JCDR* 2017;11:ZC28-30.
- McArdle LW, Patel N, Jones J, McDonald F. The mesially impacted mandibular third molar: The incidence and consequences of distal cervical caries in the mandibular second molar. *Surgeon* 2018;16:67-73.
- Al-Abdallah M, AlHadidi A, Hammad M, Dar-Odeh N. What factors affect the severity of permanent tooth impaction? *BMC Oral Health* 2018;18:184.
- Pell GJ, Gregory BT. Impacted mandibular third molars: Classification and modified techniques for removal. *Dent Dig* 1933;39:330-8.
- Hassan AH. Pattern of third molar impaction in a Saudi population. *Clin Cosmet Investig Dent* 2010;2:109-13.
- El-Khateeb SM, Arnout EA, Hifnawy T. Radiographic assessment of impacted teeth and associated pathosis prevalence. Pattern of occurrence at different ages in Saudi male in western Saudi Arabia. *Saudi Med J* 2015;36:973-9.
- Al-Dajani M, Abouonq AO, Almohammadi TA, Alruwaili MK, Alswilem RO, Alzoubi IA. A cohort study of the patterns of third molar impaction in panoramic radiographs in Saudi population. *Open Dent J* 2017;11:648-60.
- Sarode GS, Sarode SC, Prajapati G, Maralingannavar M, Patil S. Calcifying cystic odontogenic tumor in radiologically normal dental follicular space of mandibular third molars: Report of two cases. *Clin Pract* 2017;7:933.
- Lizio G, Tomaselli L, Landini L, Marchetti C. Dentigerous cysts associated with impacted third molars in adults after decompression: A prospective survey of reduction in volume using computerised analysis of cone-beam computed tomographic images. *Br J Oral Maxillofac Surg* 2017;55:691-6.
- Katsarou T, Kapsalas A, Souliou C, Stefaniotis T, Kalyvas D. Pericoronitis: A clinical and epidemiological study in Greek military recruits. *J Clin Exp Dent* 2019;11:e133-7.
- Wang D, He X, Wang Y, Li Z, Zhu Y, Sun C, *et al.* External root resorption of the second molar associated with mesially and horizontally impacted mandibular third molar: Evidence from cone beam computed tomography. *Clin Oral Investig* 2017;21:1335-42.
- Glória JCR, Martins CC, Armond ACV, Galvão EL, Dos Santos CRR, Falci SGM. Third molar and their relationship with caries on the distal surface of second molar: A meta-analysis. *J Maxillofac Oral Surg* 2018;17:129-41.
- Falci SG, de Castro CR, Santos RC, de Souza Lima LD, Ramos-Jorge ML, Botelho AM, *et al.* Association between the presence of a partially erupted mandibular third molar and the existence of caries in the distal of the second molars. *Int J Oral Maxillofac Surg* 2012;41:1270-4.
- Chang SW, Shin SY, Kum KY, Hong J. Correlation study between distal caries in the mandibular second molar and the eruption status of the mandibular third molar in the Korean population. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108:838-43.
- McArdle LW, Renton TF. Distal cervical caries in the mandibular second molar: An indication for the prophylactic removal of the third molar? *Br J Oral Maxillofac Surg* 2006;44:42-5.
- Allen RT, Witherow H, Collyer J, Roper-Hall R, Nazir MA, Mathew G. The mesioangular third molar—To extract or not to extract? Analysis of 776 consecutive third molars. *Br Dent J* 2009;206:E23; discussion 586-7.
- ADA Division of Communications, Journal of the American Dental Association, ADA Council on Scientific Affairs. For the dental patient. Tooth eruption: The permanent teeth. *J Am Dent Assoc* 2006;137:127.
- Al-Khateeb TH, Bataineh AB. Pathology associated with impacted mandibular third molars in a group of Jordanians. *J Oral Maxillofac Surg* 2006;64:1598-602.
- Ozeç I, Hergüner Siso S, Taşdemir U, Ezirganli S, Göktolga G. Prevalence and factors affecting the formation of second molar distal caries in a Turkish population. *Int J Oral Maxillofac Surg* 2009;38:1279-82.
- Sheikh MA, Riaz M, Shafi QS. Incidence of distal caries in mandibular second molars due to impacted third molars—A clinical and radiographic study. *PODJ* 2012;32:364-71.
- McArdle LW, McDonald F, Jones J. Distal cervical caries in the mandibular second molar: An indication for the prophylactic removal of third molar teeth? Update. *Br J Oral Maxillofac Surg* 2014;52:185-9.
- Srivastava N, Shetty A, Goswami RD, Apparaju V, Bagga V, Kale S. Incidence of distal caries in mandibular second molars due to impacted third molars: Nonintervention strategy of asymptomatic third molars causes harm? A retrospective study. *Int J Appl Basic Med Res* 2017;7:15-9.
- Toedting V, Coulthard P, Thackray G. Distal caries of the second molar in the presence of a mandibular third molar—A prevention protocol. *Br Dent J* 2016;221:297-302.
- Ali FM, Khan MA, Derrbishi AA, Al-Mughalis GA, AlMasrahi M, Kinani A, *et al.* Study of prevalence of caries on distal side of second mandibular molar due to impacted mandibular third molar. *Ann Int Med Den Res* 2017;3:DE41-3.
- Knutsson K, Brehmer B, Lysell L, Rohlin M. Pathoses associated with mandibular third molars subjected to removal. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996;82:10-7.
- Prajapati VK, Mitra R, Vinayak KM. Pattern of mandibular third molar impaction and its association to caries in mandibular second molar: A clinical variant. *Dent Res J (Isfahan)* 2017;14:137-42.
- Pourhoseingholi MA, Baghestani AR, Vahedi M. How to control confounding effects by statistical analysis. *Gastroenterol Hepatol Bed Bench* 2012;5:79-83.