

Incidence of Occlusal Dental Caries in Asymptomatic Third Molars

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Purpose: We sought to determine the incidence of caries experience on the occlusal surface of asymptomatic third molars erupted to the occlusal plane and to examine the association between the prevalence of caries experience in third molars and other molars.

Patients and Methods: Clinical data were collected from healthy patients (ASA Class I, II) with asymptomatic third molars enrolled at 2 clinical centers in an institutional review board-approved clinical trial. All patients with at least one third molar at the occlusal plane and with data at baseline and from the most recent of at least 2 follow-up visits were compared in the analysis. At each visit, the presence or absence of caries experience on the occlusal surface of third molars and on any surface of the first and second molars was recorded during clinical and radiographic examinations.

Results: Median time between baseline and the most recent follow-up examination was 2.9 years (interquartile range, 1.6 to 4.0 years). Patients (N = 211) were more often female (55%) and white (79%). Median age at baseline was 26.6 years (interquartile range, 22.7 to 32.6 years). At baseline, 29% of patients were affected by third molar occlusal caries, increasing to 33% at follow-up. Older patients at baseline had more caries in a third molar than those younger than 25 years (43% versus 9%). However, patients who were younger at baseline were more likely to develop caries in third molars at follow-up (9% versus 19%). Mandibular third molars were affected more often than maxillary third molars: 25% versus 19% at baseline and 29% versus 22% at follow-up. At baseline and at follow-up, nearly all patients with third molar caries, 98% and 99%, also had caries in first/second molars.

Conclusions: The 3-year caries incidence in third molars erupted to the occlusal plane was highest among younger patients and mandibular teeth. The presence of caries in first/second molars at baseline was highly predictive of the development of third molar caries during the ensuing 3 years.

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Clinicians relate that occlusal caries is a major reason for removal of third molars in young patients with good overall oral health. Because caries is an infectious disease affecting an individual patient, decisions

about appropriate treatment of carious teeth depend in part on a patient's overall caries experience.¹⁻³ However, data are limited in young adults on the relationship between the caries experience in teeth

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Table 1. BASELINE DEMOGRAPHIC DATA OF PARTICIPANTS (N = 211) WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE AND AT LEAST 2 FOLLOW-UP DATA COLLECTION VISITS

	Patients (n)
Female	115 (55%)
White	166 (79%)
African American	25 (12%)
Education at least grade 12	200 (95%)
Age	
<25 yr	86 (41%)
≥25 yr	125 (59%)
Median age (yr)	26.6 (IQR, 22.7 to 32.6)
Median follow-up time (yr)	2.9 (IQR, 1.6 to 4.0)

Abbreviation: IQR, interquartile range, 25th to 75th percentile.

Shugars et al. *Occlusal Caries in Asymptomatic Third Molars*. *J Oral Maxillofac Surg* 2005.

other than third molars and in third molars themselves, which erupt last to the occlusal plane. Therefore, clinicians have almost no information to help them determine caries risk in third molars before caries can be detected clinically.

Shugars et al.⁴ reported an association between caries experience in asymptomatic third molars and caries or restorations in first or second molars. In their cross-sectional analysis, one third of the study population had caries in third molars. Almost all of the patients with third molar caries experience had caries experience in a first or second molar. In contrast, the absence of caries experience in first or second molars was associated with caries-free third molars.

The present study was designed to determine the incidence of occlusal caries in asymptomatic retained third molars erupted to the occlusal plane and to examine the association between caries experience in other molars at baseline and the incidence of caries experience in third molars over time.

Patients and Methods

The data for these analyses are part of a larger project, which is examining the strategies for managing third molars. In that study, volunteers with 4 asymptomatic third molars with adjacent second molars were enrolled in an institutional review board-approved trial at 2 academic clinical centers, the University of Kentucky and the University of North Carolina. Participants were asked to retain third molars for the duration of the trial and were compensated for annual data-gathering visits. Inclusion criteria dictated that participants be healthy (American Society of Anesthesiologists Physical Status Classification I, II as determined by the clinician examiner) and be between the ages of 14 and 45 years at baseline. Participants who had the most severe form of peri-

odontal disease determined by clinical examination (American Academy of Periodontology IV), reported being pregnant, reported having taken any systemic antibiotics within the past 3 months, or had a history of treatment for any psychiatric disorder within the past 12 months were excluded from participation.

Baseline clinical data on caries experience for all molar teeth were collected at entry to the trial after July 1999 by a visual-tactile caries examination identical to that used in national child and adult caries studies.⁵ The same baseline clinical data for patients enrolled in the trial before mid-1999 were collected at the first annual follow-up visit after July 1999. Clinical data on caries experience were also collected at each follow-up visit for each participant in the trial. The presence or absence of caries experience (cariou lesions or restorations) on the occlusal surface of third molars erupted to the occlusal plane and on any surface of first and second molars was charted at data collection visits.

In addition to the clinical examination, panoramic radiographs that were taken at the same visit as the clinical examination were examined for restorations. The presence or absence of restorations on all molars observed on the radiographs highlighted by a conventional view box was recorded by a single dentist examiner. For additional details on data collection, see Shugars et al.⁴

The primary outcome measure for this analysis was caries experience on the occlusal surface of a third molar erupted to the occlusal plane. This surface of the third molar, which is exposed first after eruption, often contains deep occlusal fissures susceptible to the accumulation of biofilm. Caries experience on any molar was indicated as present if either a sealant, restoration, or caries were observed clinically or radiographically. Caries experience at the jaw level (maxillary or mandibular) for any molar was positive if caries experience was noted in either quadrant of that jaw. Patient level caries occurrence was positive if caries experience was noted in any molar in any quadrant in the mouth.

All patients with at least 1 third molar at the occlusal plane at baseline and with at least 2 annual follow-up visits for data collection were included in this analysis. Data from baseline and data from the most recent follow-up visit were analyzed for this study.

Frequency distributions and related summary statistics were calculated. The relationships between incident third molar experience and first/second molar caries at baseline and at follow-up were displayed in contingency tables, and χ^2 tests were used to test for significance. The relationship of first or second molar caries at baseline to the follow-up cumulative incidence of third molar caries was further evaluated using odds ratios and 95% confidence intervals, and

Table 2. FREQUENCY OF THE ABSENCE OF CARIES EXPERIENCE OF PARTICIPANTS AFTER A MEDIAN FOLLOW-UP OF 2.9 YEARS

Age (yr)		No Caries Experience					
		First and Second Molars		Third Molars		All Molars	
		n	%	n	%	n	%
<25 (n = 86)	Baseline	33	38	78	91	30	35
	Follow-up	24	28	70	81	23	27
≥25 (n = 125)	Baseline	22	18	71	57	21	17
	Follow-up	21	17	71	57	19	15
Total (N = 211)	Baseline	55	26	149	71	51	24
	Follow-up	45	21	141	67	42	20

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the diagnostic utility of first or second molar caries at baseline to predict third molar caries incidence was evaluated using positive and negative predictive value. While sensitivity and specificity are more often used for population screening, predictive value was chosen in this analysis because of its greater applicability to individual clinical diagnoses.

Results

Baseline and follow-up data were available for a total of 211 participants who were seen during a 4-year period (Summer 1999 to Fall 2003). Most of the participants were female (55%) and white (79%) (Table 1). Almost all had completed high school. The median age of the patients at baseline was 26.6 years (interquartile range, 22.7 to 32.6 years). Almost 60% were 25 years or older. The median time after baseline for follow-up data collection was 2.9 years (interquartile range, 1.6 to 4.0 years).

At baseline, only about a fourth of patients had no clinical or radiographic evidence of caries or restorations in any molar tooth, whereas a fifth were caries free at follow-up (Table 2). At baseline, 71% of patients had no evidence of occlusal caries experience in any erupted third molar compared with 67% at follow-up, with the bulk of the disease since baseline occurring among those in the under-25-year-old cohort.

Overall, third molar occlusal caries experience increased from 29% of patients at baseline to 33% at the most recent follow-up (Table 3). In the older age cohort (≥25 years), 43% had third molar caries at baseline and at follow-up. Thus, almost all of the new third molar caries occurred in patients younger than 25 years.

Younger patients had lesser prevalence of third molar caries in either jaw at both data-collecting periods. More mandibular third molars had evidence of caries experience at baseline than was evident in maxillary third molars, 37% versus 29% (Table 4). Both mandibular third molars were affected more often than both maxillary third molars at baseline and follow-up. At follow-up almost all of the caries occurrence by jaw was in the younger age cohort: maxillary third molars, 5% to 8%, and mandibular third molars, 7% to 17%.

At baseline, 74% of participants had evidence of caries experience in a first or second molar (Table 5). Although the data are not presented in the table, analysis shows that if patients had first/second molar caries, 37% also had third molar caries. At follow-up, 79% of patients had evidence of caries experience in a first or second molar; 40% also had third molar caries. Caries experience was not unique to third molars either at baseline or at follow-up. Only 4 patients (2%) at baseline and 3 patients (1%) at follow-up had occlusal third molar caries experience with no evidence of caries experience in a first or second molar.

Caries experience in a first or second molar at baseline was a good predictor of subsequent third molar caries. Of the 151 participants who had no caries in third molars at baseline, persons with baseline caries in any first or second molar were 1.5 times more likely to develop caries in a third molar over the follow-up period (12% versus 7.8%). However, this difference was not statistically significant. Negative predictive value of having no caries in a first or second molar at baseline was quite good at 92%, but the positive predictive value of having baseline caries in a first or second molar was only 12.0% (Table 6).

Table 3. FREQUENCY OF CARIES EXPERIENCE OF PARTICIPANTS AT BASELINE AND A MEDIAN FOLLOW-UP OF 2.9 YEARS

Age (yr)		Caries Experience			
		Any Third Molar		Any First or Second Molar	
		n	%	n	%
<25 (n = 86)	Baseline	8	9	53	62
	Follow-up	16*	19	62	72
≥25 (n = 125)	Baseline	54	43	103	82
	Follow-up	54	43	104	83
Total (N = 211)	Baseline	62	29	156	74
	Follow-up	70*	33	166	79

*Data do not include 8 participants who had third molars with caries removed since baseline, a decision made by the patient in consultation with the general dentist.

Sbugars et al. Occlusal Caries in Asymptomatic Third Molars. J Oral Maxillofac Surg 2005.

Table 4. PARTICIPANTS BY AGE AT BASELINE WITH CARIES EXPERIENCE IN AT LEAST 1 THIRD MOLAR BY JAW, BASELINE AND FOLLOW-UP, MEDIAN 2.9 YEARS

Age (yr)		Caries Experience							
		Any Maxillary Third Molar		Both Maxillary Third Molars		Any Mandibular Third Molar		Both Mandibular Third Molars	
		n	%	n	%	n	%	n	%
<25 (n = 86)	Baseline	4	5	2	2	6	7	2	2
	Follow-up	7	8	1	1	15	17	5	6
≥25 (n = 125)	Baseline	37	29	17	13	47	37	25	20
	Follow-up	39	31	17	13	47	37	26	21
Total (N = 211)	Baseline	41	19	18	9	53	25	27	13
	Follow-up	46	22	18	9	62	29	31	15

NOTE. After baseline, 8 participants had third molars removed because of caries.

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If the “at-risk” third molar teeth were considered, a similar pattern emerged (Tables 7, 8). With 694 third molars at the occlusal plane divided almost evenly between the jaws, the change in caries experience occurred principally in the younger age cohort. More mandibular third molars were affected in both age cohorts.

Discussion

The principal finding of this longitudinal analysis was that occlusal caries experience is a continuing process in all molars. Intuitively, clinicians might conclude that the position of third molars in the jaw and the anatomy of the occlusal surface of third molars, often with deep, multiple, occlusal fissures, might lead to accumulation of biofilm on the tooth surface

and, over time, the development of dental caries. However, as indicated in a report from a National Institutes of Health consensus panel directed to caries management, caries is now seen by clinicians and the informed public as an infectious disease requiring the presence of specific, acid-forming bacteria colonized in the biofilm attached to the tooth surface.⁶ In our study if no caries experience was detected on first or second molars, detecting third molar caries was highly unlikely, with a negative predictive value of 0.92. However, the presence of caries on a first or second molar did not predict the subsequent development of caries on a third molar particularly well (low positive predictive value) within the rather short median follow-up time of this study.

Previous caries experience, which indicates that cariogenic bacteria have been present and destructive, remains the best predictor of future caries across all age groups studied.^{2,3} Most data were derived from studies on children, adolescents, or older adults. Our data on young adults assume more importance because third molars were included in the analysis and data were reported from a cohort mostly in the third decade of life. If young adults with good oral health have no evidence that caries-producing bacteria colonized in the biofilm on the surface of their molar teeth have been active, in the short term third molar caries is unlikely.

Our data indicated a lower overall prevalence of caries in third molars at baseline and follow-up compared with first/second molar caries experience. At baseline and follow-up, more mandibular third molars were affected by caries than were maxillary third molars. Over time in our study the incidence of caries changed only in the younger study cohort, those younger than 25 years. These data also are compatible with the current view of the pathobiology of caries. Even though patients may have had caries bacteria

Table 5. PARTICIPANTS WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE COMPARED BY CARIES EXPERIENCE ALONE, OR ASSOCIATED WITH CARIES EXPERIENCE IN ANY FIRST OR SECOND MOLAR, AT BASELINE AND FOLLOW-UP, MEDIAN 2.9 YEARS

	Any First or Second Molar		Any Third Molar			
	n	%	Yes		No	
			n	%	n	%
Baseline caries experience						
Yes	156	74	58	27	98	46
No	55	26	4	2	51	24
Total	211		62		149	
Follow-up caries experience						
Yes	166	79	67	32	99	47
No	45	21	3	1	42	20
Total	211		70		141	

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Table 6. ASSOCIATION BETWEEN PRESENCE OF FIRST OR SECOND MOLAR CARIES AT BASELINE WITH INCIDENCE OF THIRD MOLAR CARIES AT FOLLOW-UP AMONG THOSE WHO WERE FREE OF THIRD MOLAR CARIES AT BASELINE

Caries-Free Third Molars at Baseline and Baseline Caries Any First or Second Molar	Follow-up Any Third Molar Caries (n)	
	Yes	No
Yes 100	12	88
No 51	4	47

Sensitivity: 12 of 16 = 75.0%; specificity: 47 of 135 = 34.8%; Positive predictive value: 12 of 100 = 0.12; negative predictive value: 47 of 51 = 0.92.

Shugars et al. Occlusal Caries in Asymptomatic Third Molars. J Oral Maxillofac Surg 2005.

colonized in their accumulated biofilm for a protracted time, more likely in the mandible than the maxilla, it may take several years for caries to be clinically detectable in third molars, which erupt usually at the end of the second decade of life.⁷ The occlusal surface of a third molar is exposed and susceptible first after eruption.

Only a fourth of our young, healthy study participants were caries free at baseline. Overall, few adults remain caries free, but most young adults have caries experience in only a few permanent teeth.^{2,5,6,8,9} Over the latter part of the last century, the prevalence of caries in the US population has decreased, but the pattern of the disease has changed. A few "high-risk" patients seem to be afflicted by a rapid progression of the disease. For most others, caries progression is slow. Our data are compatible with these observations. Our young patients, enrolled with good oral health and few active caries lesions or restorations, would be expected to have a low caries incidence. However, recently erupting third molars would be susceptible to the disease if caries-producing bacteria were already colonized in a patient's biofilm.

By charting caries experience using an epidemiologic clinical assessment and findings from a panoramic radiograph, our assessment of caries experience could result in either an underestimate or an overestimate. For example, the observation of a restoration in a molar in our cohort of patients may not always represent a previous carious lesion. Our data, then, would overestimate caries experience, or having bite-wing radiographs of all molar teeth on our study patients might have detected additional caries. Our caries experience data would be underestimated. These limitations that exist for our study were discussed in more detail by Shugars et al⁴ and are shared across most studies of caries prevalence.

Our findings to date from this longitudinal analysis, coupled with the increased emphasis on a patient's

cumulative caries experience as a predictor of future caries, are quite helpful to clinicians who must advise patients about retaining or removing vertically positioned third molars at or just below the occlusal plane. Data from our study population suggest that more than 40% of patients 25 years old or older can expect caries experience in a third molar before the end of the third decade of life. Mandibular third molars seem more susceptible than maxillary molars. Almost all would have previous caries experience in other molars. Conversely, about 60% do not exhibit caries experience. Our findings that our older age cohort showed almost no change in caries experience from baseline to follow-up suggests that patients early in the third decade are the most susceptible to third molar caries. As further data are accumulated over time from participants in this longitudinal trial, it will be important to assess whether these findings remain.

If a patient is in the third decade and has vertically positioned noncarious third molars at the occlusal plane with good periodontal support, and first and second molars with no caries experience, it seems unlikely that occlusal caries will develop rapidly if at all, unless a patient's overall oral health status deteriorates. If the anatomy of the occlusal surface of the third molars and the position of the teeth in the jaw make biofilm accumulation difficult to prevent, perhaps targeted caries preventive measures for third molars, such as occlusal sealants, might be appropriate.

If a patient has caries experience in first/second molars, a different decision must be considered for a patient just completing skeletal growth. Assuming good periodontal support for third molars at or just below the occlusal plane and continuation of the patients' good overall oral and systemic health, the clinical decision hinges on the economic value of retaining third molars that are caries susceptible and may require treatment over the life of the patient. Removal of third molars may be the more prudent option. If the third molar is retained, careful monitoring and preventive caries treat-

Table 7. THIRD MOLARS AT THE OCCLUSAL PLANE BY AGE AT BASELINE WITH CARIES EXPERIENCE, BASELINE AND FOLLOW-UP, MEDIAN 2.9 YEARS

Age (yr)		Third Molars	
		n	%
<25 (n = 250)	Baseline	14	6
	Follow-up	28	11
≥25 (n = 444)	Baseline	126	28
	Follow-up	129	29
Total (N = 694)	Baseline	139	20
	Follow-up	157	23

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Table 8. THIRD MOLARS AT THE OCCLUSAL PLANE BY AGE AT BASELINE WITH CARIES EXPERIENCE BY JAW, BASELINE AND FOLLOW-UP, MEDIAN 2.9 YEARS

Age (yr)		Maxillary Third Molars		Mandibular Third Molars		
		n	%	n	%	
<25	Baseline (n = 121)	6	5	Baseline (n = 129)	8	7
	Follow-Up	8	7	Follow-Up	20	16
≥25	Baseline (n = 223)	54	24	Baseline (n = 221)	73	33
	Follow-Up	56	25	Follow-Up	74	33
Total	Baseline (n = 344)	59	17	Baseline (n = 350)	80	23
	Follow-Up	64	19	Follow-Up	93	27

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ment should be done at least until the patient completes the third decade of life.

Our data indicated that in the mandible, both third molars become carious over one third of the time when one mandibular third molar is carious. These data support the removal of both mandibular third molars if the decision is for surgery. The data for the maxilla are not so clear. However, if both mandibular third molars are removed because of a risk for caries, it seems prudent to remove all third molars at the same operation.

At baseline, 62% of the younger cohort had caries experience on a first or second molar; this percentage increased to 72% during the 2.9-year median follow-up period. By contrast, at follow-up in this same younger cohort, 70 of 86 (81%) patients had no evidence of third molar caries. How many of these patients will develop third molar caries over time? Is there a clinically applicable predictor for future caries experience? By continuing to collect data on caries experience from our study participants in the longitudinal trial, particularly those in the younger cohort, we hope to amplify these findings. It is possible that the association between caries experience in a first molar or caries experience in an adjacent second molar may prove to be a risk factor for caries in a recently erupted third molar. These associations will be explored further in the clinical trial.

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