

Occlusal Caries Experience in Patients With Asymptomatic Third Molars

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Purpose: Our goals were to determine the prevalence of caries experience, carious lesions, or restorations on the occlusal surface, in asymptomatic third molars erupted to the occlusal plane, and to examine the association between caries experience in other molars and third molars within the same mouth and quadrant.

Patients and Methods: Clinical data assessing oral health were collected from healthy patients (ASA I, II). 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. The occurrence of caries experience for younger and older subjects was compared using the general association Cochran-Mantel-Haenszel statistic and the association of occurrence in the maxilla and mandible by the McNemar test. The association between caries experience in a third molar and caries experience in first and second molars also was assessed.

Results: Overall, 28% of the 303 patients with at least 1 third molar at the occlusal plane were affected by third molar caries. Patients 25 years or older had more caries experience in a third molar than those younger than 25 years, 39% versus 11% ($P < .0001$). Mandibular third molars were affected more often than maxillary third molars, 24% versus 18% ($P < .0001$). Nearly all patients, 76 of 80 (95%), with third molar caries experience also had caries experience in first/second molars, but only 80 of 223 (36%) of patients with first/second molar caries experience had a history of third molar caries.

Conclusions: The prevalence of caries in third molars erupted to the occlusal plane in these young patients was high, but not unique to third molars, particularly in those 25 years of age and older. Although these results provide a baseline description of the association between caries experience in first/second molars and associated third molars, data are needed from longitudinal studies to determine the value of first/second molar caries experience in predicting the risk of caries in third molars.

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Oral health continues to improve due to an emphasis on preventive dentistry, widespread fluoridation, and increased public education. A 27% decrease in the decayed/missing/filled surfaces (DMFS) in adults 18 to 45 years of age was found between epidemiologic surveys of the US population conducted 2 decades apart.¹ The most improvement was seen in the youngest cohort, a 44% improvement in those 18 to 25 years. However, no data were collected on third molars; most epidemiologic surveys of caries prevalence do not include third molars.

The presence of occlusal caries in third molars erupted to the occlusal plane is a major reason for removal of third molars in patients with good overall oral health. However, little data are available on the extent of this clinical problem. There is growing acknowledgment that caries is an infectious disease affecting an individual patient and decisions about appropriate treatment depend in part on patients' overall caries experience.² Yet clinicians have no information to help them determine caries risk in third molars because there are no data on the relationship between the caries experience of other molars in the mouth and third molars.

This study was designed to assess the prevalence of occlusal caries experience in asymptomatic third molars erupted to the occlusal plane, defined as an existing occlusal carious lesion or restoration, and to determine the association between caries experience in other molars and third molars within the same mouth and quadrant.

Patients and Methods

The data for these cross sectional analyses are part of a larger project, which is an examination of the outcomes of strategies for managing third molars. In that study, volunteer patients 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. Patients were asked to retain third molars for the duration of the trial and were compensated for data gathering visits. Inclusion criteria dictated that patients be healthy, be of American Society of Anesthesiologists Physical Status Classification (ASA I, II) as determined by the clinician examiner, and be between the ages of 14 and 45 years. Patients who had the most severe form of periodontal disease (AAP IV) determined by clinical examination, 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.

Clinical data on caries experience were collected on all patients 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.³ The clinical investigators conducting the examination for caries experience were calibrated in 1999 before collecting clinical caries data from enrolled patients. The clinical calibration achieved an 85% agreement among the clinical investigators. The same clinical data for patients enrolled in the trial before mid 1999 were collected at the first annual follow-up visit after July 1999. The presence or absence of caries experience (carious lesions or restorations) in the occlusal surface of third molars erupted to the occlusal plane and on any surface of first and second molars was charted. In addition to the clinical examination, panoramic radiographs, taken at the same visit as the examination for clinical data, were examined for restorations. The presence or absence of restorations on all molars observed on the radiographs highlighted by a conventional viewbox were recorded by a single dentist examiner. Intraexaminer reliability was assessed by comparing initial ratings with the ratings obtained on a reexamination of 20 patient radiographs (240 molar teeth) conducted 5 months after the initial readings. There was 100% agreement for data between the first and second radiographic readings.

The primary outcome measure was the caries experience on the occlusal surface of a third molar erupted to the occlusal plane. Third molar caries experience was indicated as present if a sealant, restoration, or caries were observed clinically or radiographically on the occlusal surface. First/second molar caries experience was indicated as present if a sealant, restoration, or caries were observed clinically or radiographically on any surface of either the first or second molar. While presence of a sealant or restoration did not ensure that caries was or would have been present, it corresponded to patients with a high likelihood of caries experience. Jaw level caries occurrence 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.

The rationale to compare the caries experience of patients under and over 25 years of age was based on the literature that indicates that most patients decide to retain third molars or have them removed before the middle of the third decade of life. Kugelberg et al⁴ have shown that periodontal problems on the distal of second molars are more likely if third molars are removed after 25 years of age. Blakey et al⁵ have reported that increased periodontal probing depths (≥ 5 mm) were more likely in the third molar region after 25 years of age whether the third molars were

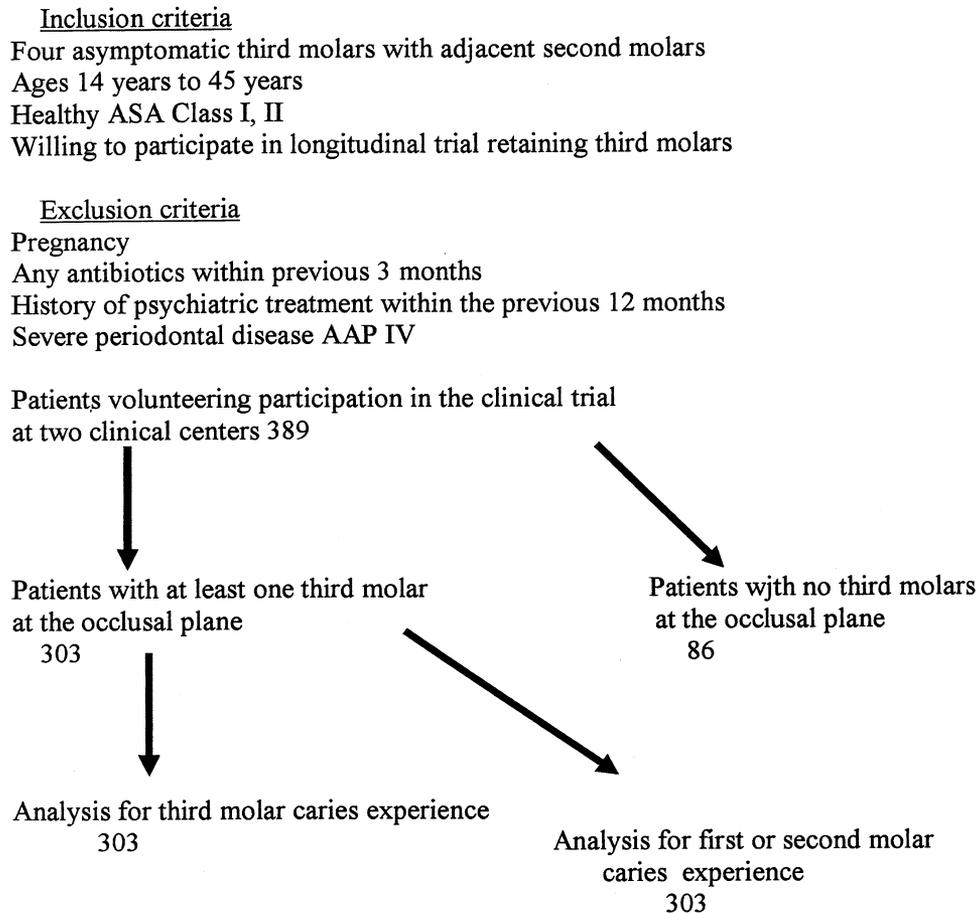


FIGURE 1. Flow of patients from enrollment to analysis.

erupted to the occlusal plane or not. The occurrence of caries in third molars and in first/second molars was compared between younger (<25 years) and older (≥ 25 years) patients using the Cochran-Mantel-Haenszel general association statistic and the association between the occurrence of caries in the maxilla and mandible using the McNemar test. Statistical significance was set at $P < .05$.

Results

As of September 2002, 389 patients had been enrolled in the clinical trial. Eighty-six patients were not included in this analysis because none of the third molars were at the occlusal plane (Fig 1). The 303 patients with at least 1 third molar at the occlusal plane were older than those without a fully erupted third molar (median age, 26.6 years versus 21.9 years) (Table 1). Fewer patients with no third molars erupted to the occlusal plane had finished high school, a finding compatible with the age range of this younger group. The other demographic characteristics of the 303 patients with a third molar at the

occlusal plane were similar to those of the 86 patients without.

Of the 303 patients included in this study, 221 (73%) had 4 third molars at the occlusal plane and 24 (8%) had only 1 third molar at the occlusal plane. Most patients had both third molars in a jaw at the occlusal plane: maxilla, 80%, and mandible, 82%. Older patients were more likely than younger patients to have all four third molars at the occlusal plane: 81% versus 61%.

Twenty-eight percent of the 303 patients had a carious lesion or restoration in at least 1 third molar (Table 2): 18% in at least 2 third molars (data not in the table). Seventy-four percent of the patients had a caries experience on at least 1 first or second molar. Overall, patients 25 years or older had more caries experience in third molars than those younger: 39% versus 11% ($P < .0001$). When caries experience is examined within subjects, 5 of 126 (4%) of the cohort younger than 25 years had third molar caries in both the maxilla and the mandible, whereas 40 of 177 (23%) of the older cohort (≥ 25 years old) had third molar caries in both jaws ($P < .0001$) (Tables 3, 4). In

Table 1. DEMOGRAPHIC CHARACTERISTICS OF THE 389 ENROLLED SUBJECTS AND SEPARATELY FOR THOSE WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE AND THOSE WITH NO THIRD MOLAR AT THE OCCLUSAL PLANE

	Patients Enrolled (n = 389)		Patients With at Least 1 Third Molar at Occlusal Plane (n = 303)		Patients With No Third Molars at Occlusal Plane (n = 86)	
	No.	%	No.	%	No.	%
Female	209	54	160	53	49	52
Median age (yr)	25.3 (21.9 to 31.5)*		26.6 (22.6 to 32.6)*		21.9 (19.0 to 25.4)*	
White	296	76	225	75	71	80
Black	58	15	46	15	12	14
Education > grade 12	365	94	294	97	71	83

*IQ, interquartile range, 25th to 75th percentile.

both age cohorts, discordance in caries experience between jaws indicated a significantly higher proportion of patients who had third molar caries experience in the mandible but not the maxilla: 7 of 126 (6%) for the younger cohort and 20 of 177 (11%) for the older cohort ($P < .0001$).

The relationship between the caries experience in first and second molars with that in third molars was examined at 2 levels. The first level was to determine the concordance/discordance for the occurrence of caries experience between third molars and adjacent molars within a quadrant. The second level was to determine the relationship at a patient level between the occurrence of a caries experience in any third molar and the occurrence of caries in any first/second molar within the mouth.

Tables 5 and 6 display the association between caries experience in first/second molars and third molars in the same quadrant and anywhere in the mouth respectively. Nearly all patients, 76 of 80 (95%), with third molar caries experience also had caries experience in first/second molars somewhere in the mouth, but many fewer patients, 80 of 223 (36%), with first/second molar caries experience had a history of third molar caries.

Discussion

Based on our findings it is likely that not less than 22% and not more than 33% (95% confidence interval) of young adults with third molars erupted to the occlusal plane could be affected by occlusal caries in a third molar. Current epidemiologic surveys do not collect data on caries in third molars.¹ Adding data on the prevalence of caries or a restoration in a third molar clearly would alter the reported caries status, the DMFS and the decayed surfaces (DS) rate, of adults in the United States.

As discussed by Blakey et al,⁵ the patients enrolled in the longitudinal clinical trial and analyzed by us comprise a reasonably diverse cohort. The number and position of third molars by age are quite similar to the epidemiologic estimates reported by Hugoson and Kugelberg.⁶ Hispanic patients are underrepresented. Because third molars are not examined for current epidemiologic estimates of caries, the impact of adding data from Hispanic patients cannot be determined. Education levels among our cohort are higher than the US population. If data collected on teeth other than third molars are indicative of the prevalence of third molar caries, including patients

Table 2. DISTRIBUTION OF PATIENTS (303) WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE, WITH CARIES EXPERIENCE IN ANY THIRD MOLAR, IN ANY OTHER MOLAR, OR BOTH IN THE SAME QUADRANT, BY AGE

Age (yr)	Caries Experience					
	At Least 1 Third Molar		At Least 1 First or Second Molar		Third Molar and First or Second Molar in Same Quadrant	
	No.	%	No.	%	No.	%
<25 (n = 126)	14	11	79	63	9	7
≥25 (n = 177)	70	39	144	81	64	36
Total (N = 303)	84	28	223	74	73	24

NOTE. Caries experience in third molars and in first or second molars was statistically significantly different between the younger and older patients, $P < .0001$.

Table 3. DISTRIBUTION OF PATIENTS (303) WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE BY AGE AND JAW

Maxilla	Mandible	
	Yes	No
Third molar caries experience <25 years old, n = 126		
Yes	5	2
No	7	112
Third molar caries experience ≥25 years old, n = 177		
Yes	40	9
No	20	108

NOTE. Difference by age and jaw are statistically significant, $P < .0001$.

with less education could increase the prevalence of third molar caries.¹

In our study the cohort in the age group over 25 years appear to be more at risk, consistent with the findings of Brown et al's¹ analysis of data from epidemiologic surveys, NHANES I and III. However, age appears to be a proxy for time. Third molars are the last teeth to erupt and usually do not erupt to the occlusal plane until jaw growth is almost complete, the late teen years for most patients. Once the third molars erupt, caries takes time to develop in susceptible patients. In adults exposed to fluoridated water, progression of a carious lesion through enamel may take an estimated 6 to 8 years.⁷

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 overestimate. For example, observing a restoration in a molar in our cohort of patients may not always represent a previous carious lesion. Bader et al³ have indicated that dentists recommend treatment for teeth more often than a clinical epidemiologic assessment would indicate the teeth as carious. This could be because additional information, such as access to radiographs targeted to caries, was available. Our un-

Table 5. DISTRIBUTION OF PATIENTS WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE (303) WHO HAVE THIRD MOLAR CARIES EXPERIENCE WITH OR WITHOUT CARIES EXPERIENCE ON THE FIRST OR SECOND MOLAR IN THE SAME QUADRANT

First or Second Molar Caries Experience in Same Quadrant	Patients With Third Molar Caries Experience	
	Yes	No
Yes (n = 223)	73	150
No (n = 80)	11	69

derstanding of the biology of caries and what is optimal treatment continues to evolve. Dentists have no clear guidelines to indicate when a tooth should be restored or observed. A dentist might treat questionable carious lesions to prevent progression of the lesions in a patient highly susceptible to caries. In view of this, equating the presence of a restoration with caries experience may overestimate the prevalence of caries. Conversely, an epidemiologic assessment of a nonrestored tooth could underestimate the prevalence of caries because the examiner does not have the same information available in the typical dental treatment room such as radiographs targeted to caries detection. These limitations that exist for our study are shared across most studies of caries prevalence.

Rarely was caries or a restoration found only in a third molar when there was no caries experience in an adjacent first or second molar in the same quadrant. More often, a first or second molar in the same quadrant had been affected by caries (Tables 2-5). This association was consistent when analyzed at the patient level. Caries experience only in a third molar without any caries experience in any first or second molar was very rare (4 of 80 [5%]) (Table 6). Older patients were more likely to have caries experience in any molar examined. These findings are in concert

Table 4. DISTRIBUTION OF PATIENTS (303) WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE, WITH CARIES EXPERIENCE IN AT LEAST 1 THIRD MOLAR AND THE THIRD MOLAR AND ANOTHER MOLAR IN THE QUADRANT, BY JAW AND AGE

Age (yr)	Caries Experience							
	Maxilla				Mandible			
	Third Molar		Third Molar and First or Second Molar in Same Quadrant		Third Molar		Third Molar and First or Second Molar in Same Quadrant	
	No.	%	No.	%	No.	%	No.	%
<25 (n = 126)	7	6	5	4	12	10	8	6
≥25 (n = 177)	49	28	48	27	60	34	55	31
Total (N = 303)	56	18	53	17	72	24	63	21

NOTE. Patients could have caries experience in 1 jaw only or in both jaws.

Table 6. DISTRIBUTION OF PATIENTS WITH AT LEAST 1 THIRD MOLAR AT THE OCCLUSAL PLANE (303) WHO HAVE THIRD MOLAR CARIES EXPERIENCE WITH OR WITHOUT CARIES EXPERIENCE ON A FIRST OR SECOND MOLAR SOMEWHERE IN THE MOUTH

At Least 1 First or Second Molar With Caries Experience in Any Quadrant	Patients With at Least 1 Third Molar With Caries Experience	
	Yes	No
Yes (n = 223)	80	143
No (n = 80)	4	76

with current theories on caries as an infectious disease.^{2,8} Pathogenic bacteria for caries, principally *S. mutans*, colonize in accumulating biofilm, dental plaque. If unchecked by local immune mechanisms that exist chiefly in saliva, these bacteria will spread such that the temporal sequencing of lesions will likely be in adjacent teeth, and in other quadrants of the mouth over time.

As discussed earlier, the clinical diagnosis of caries, its progression, and optimal treatment are less clear to clinicians than might be expected considering the extensive experience clinicians have with the disease. For example, the use of a sharp explorer to detect caries is now discouraged because the instrument may contribute to enamel demineralization and penetration of the pathogenic bacteria deeper into tooth structure.⁹ The visual method alone seems to be as effective in diagnosing caries as the combined visual plus tactile method. Clinicians are now charged to consider the tooth as only one unit in an oral environment. A patient's overall susceptibility to caries, viewed as the sum total of caries affecting individual teeth, improves a clinician's ability to better predict and manage caries successfully.^{9,10} Our data indicating that caries is not unique to third molars but part of a pattern of caries affecting the patient support this diagnostic approach.

Clinicians face more uncertainty about the most effective treatment for suspected caries than might be expected by patients unaware of the pathogenesis of caries. Because so little data are available on third molars, a dentist has an even more difficult decision about recommending treatment. The anatomic location of third molars making restorations more technically complicated coupled with patients' increased difficulty keeping third molars free of accumulating dental plaque, make it seem likely that these teeth would require replacement restorations several times over a lifetime. General dentists often recommend reasonably that third molar removal is the option of choice when third molar caries is suspected. Still some uncertainty remains about this decision.

Rosensteil¹¹ highlighted the clinical dilemma faced by clinicians by noting that a decision in favor of overtreatment is often made in the face of uncertainty. No judgment can be made about such a decision because the clinician has little data to predict what will happen for that patient in the future. Having data to indicate who is at high risk for pathology associated with third molars would support treatment recommendations and would be very helpful to health care professionals and the patients they counsel.

Although clinicians welcome knowledge of clinical signs or symptoms, such as the caries experience of first and second molars, to predict the risk of future caries in third molars, this cross-sectional analysis does not allow the use of these data to predict third molar caries experience. It does provide excellent information on caries experience in molars that can serve as a baseline for the ongoing longitudinal study. At the conclusion of that study, we will be in a better position to provide estimates of the predictive validity of caries experience in first and second molars. With supporting data available, a data-based monitoring protocol targeting third molars can be developed.

In light of our findings and the fact that many patients seek guidance about third molar treatment, the issue of the most appropriate treatment for decayed third molars erupted to the occlusal plane must be considered before we have additional data. Perhaps a restoration is optimal if caries is detected early in a third molar, soon after eruption to the occlusal plane, and patients are in good oral health with no other molars having been affected by caries. As part of a monitoring and treatment protocol for retained third molars, the general dentist must be vigilant and detect occlusal caries as soon as it is obvious that a vertically positioned third molar reaching the occlusal plane will be retained.

Clearly, individual patients are interested in the options for treating their third molars. Perhaps just as important are more global health care issues. How many patients might be at risk for developing pathology associated with third molars? If Hugoson and Kugelberg's data gathered from a communitywide survey in Sweden can be applied to the US population, 95% of the 20 million individuals 15 to 19 years of age have at least 1 third molar; 75% have 4 third molars.^{6,12} At age 20 years, more than half of all maxillary third molars are erupted; more than one fourth of mandibular third molars are erupted, all susceptible to caries. The data obviously are biased toward individuals with a northern European ethnic background. Even if the number of individuals with third molars in the US population is somewhat lower, a high percentage of the individuals in this age group

face a decision about third molar treatment in any year.

Our findings are consistent with the concept of caries as an infectious disease. Caries is not isolated to third molars, nor should a decision about treatment be made just considering individual third molars. The potential for third molar caries and the most appropriate treatment must be viewed in the context of a patient's overall oral health before a decision or recommendation about treatment or monitoring third molars can be made.

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