

# Reliability of Third Molar Probing Measures and the Systemic Impact of Third Molar Periodontal Pathology

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**Purpose:** This study examined the reliability of assessing clinical periodontal measures on third molars, and the association between oral inflammation with periodontal pathology including third molars, and systemic inflammation including negative obstetric outcomes.

**Patients and Methods:** Reliability of third molar probing depth (PD) was assessed for 41 patients by trained examiners. The data for the association between oral inflammation with periodontal pathology and systemic outcomes were derived from an IRB-approved study, "Oral Conditions and Pregnancy." Full mouth periodontal exams including third molars were conducted at less than 24 weeks of pregnancy. Periodontal status, moderate/severe periodontal disease (15 or more sites PD  $\geq$ 4 mm) was considered as a possible predictor of systemic inflammation and pre-term birth. The upper quartile of the extent of PD for third molars alone (PD  $\geq$ 4 mm) also was considered as a possible exposure variable for the same outcomes. Chi-square and *t* tests were used to determine statistical significance (0.05). Significant predictor variables were included in multivariate models. Unconditional logistic multivariate models were used to derive odds ratios (OR) and 95% confidence intervals (CI).

**Results:** Reliability of PD within 1 mm was excellent, and similar for third molars and non-third molars. Data from 1,020 obstetric patients were available for analysis. Eighteen percent of the patients delivered preterm, at less than 37 weeks. Having moderate/severe periodontal disease excluding third molars, was significantly associated with preterm birth ( $P = .008$ ). Results were more significant if third molars were included ( $P = .0005$ ). With multivariate models moderate/severe periodontal disease at enrollment including third molar PD, was associated with preterm birth (OR, 1.7; 95% CI, 1.1, 2.6). If only the extent of third molar PD was considered, odds also were increased for preterm birth (OR, 2.4; 95% CI, 1.1, 5.2). If only the extent of third molar PD was considered at enrollment, odds were increased for serum markers of systemic inflammation, elevated serum CRP, and oxidative stress, 8-isoPGF<sub>2 $\alpha$</sub> .

**Conclusions:** Dental examiners could reliably assess clinical periodontal measures on third molars. Third molars should be included in studies of systemic outcomes associated with oral inflammation. Women of child-bearing age should be made aware of the systemic risks of oral inflammation with third molar periodontal pathology.

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Most often clinical trials assessing the extent of periodontal pathology do not include third molars. For

example, Haffjee et al<sup>1</sup> studied the association between clinical measures of periodontal disease and

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the site prevalence of periodontal pathogens for periodontally healthy young subjects, periodontally maintained older subjects, and those with active disease. Subgingival plaque samples to identify periodontal pathogens were taken from the mesial of all teeth except third molars. Salvi et al<sup>2</sup> studied gingival crevicular fluid (GCF) inflammatory mediators in insulin-dependent diabetic patients with periodontal disease and periodontally healthy control patients. Third molars were not included in the analyses.

However, Blakey et al<sup>3</sup> reported that 25% of 329 patients in the third decade of age with asymptomatic third molars had at least one periodontal probing depth (PD) greater than or equal to 5 mm with attachment loss in the third molar region, the distal of second molars or around third molars. If patients were older than 25 years, 33% had at least 1 PD greater than or equal to 5 mm. High levels of periodontal pathogens, "orange" and "red" complex bacteria, and increased GCF IL-1 $\beta$  levels were found with PD greater than or equal to 5 mm in the third molar region for these same patients.<sup>4,5</sup> The patients of Blakey et al<sup>3</sup> were periodontally healthy if the third molar region was excluded from analysis; only 4 patients had PD greater than or equal to 5 mm at periodontal probing sites on more anterior teeth.

Third molars are affected with periodontal pathology often enough that these teeth should be included in assessments of periodontal disease. Studies that consider oral inflammation with periodontal pathology as an exposure for systemic conditions have become more common. In this context third molars cannot be ignored as a possible source of infection and oral inflammation. However, no data exist to document that visible third molars can be assessed clinically as accurately as other teeth in the mouth. This study was designed to examine the reliability of assessing clinical periodontal measures on third molars as compared to non-third molar teeth.

In addition the association at enrollment of the periodontal status of third molars alone, and the periodontal status of other teeth including third molars, with a negative obstetric outcome, preterm birth at less than 37 weeks, were analyzed. The impact of these same predictors on the level of markers of an accompanying systemic inflammatory response at enrollment, elevated serum C-reactive protein (CRP), and elevated serum 8-isoPGF<sub>2 $\alpha$</sub>  (d8iso) was assessed also.

## Patients and Methods

Institutional review board approval was obtained to conduct the clinical studies.

Reliability of third molar PD and attachment loss (AL) was assessed at calibration sessions with volunteer subjects at the UNC School of Dentistry. For the trained dentist and dental hygienist examiners, intraclass correlations (ICC) and Kappa scores were calculated for the clinical periodontal measures.

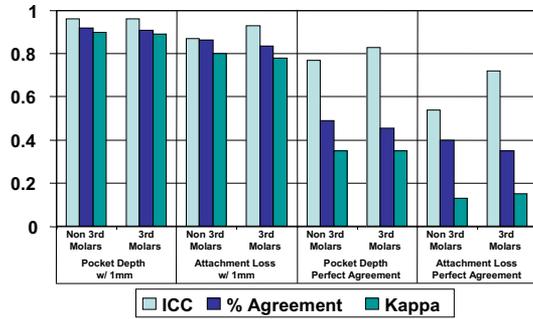
The data for the association between oral inflammation and systemic outcomes were derived from a larger project involving obstetric patients who were enrolled and followed through pregnancy in a prospective exploratory trial, "Oral Conditions and Pregnancy" (OCAP).<sup>6</sup> Eligible patients had to be enrolled before 26 weeks gestation. Patients with systemic illness that predisposed to periodontal disease, such as diabetes mellitus, or to preterm birth, such as chronic hypertension, were excluded. Patients who required antibiotic prophylaxis for periodontal exams also were excluded.

Demographic, health behavior, and medical history data were obtained from each patient's medical record. These data included preexisting medical problems, previous pregnancy history, results of the current prenatal exam including current gestational age confirmed by ultrasound, and obstetric outcomes. Serum samples for levels of markers for maternal systemic inflammation, CRP, and oxidative stress, d8iso, were obtained at enrollment. For additional details on the design and conduct of OCAP please see Lieff et al.<sup>6</sup>

The research dental hygienists who conducted the periodontal exams for OCAP were calibrated initially and at annual intervals. Full mouth periodontal exams, 6 probing sites for each tooth visible in the mouth including third molars, were conducted at less than 24 weeks of pregnancy. Examiner reliability assessed by weighted Kappa scores was greater than 85%, and intraclass correlation coefficients were 0.90 or higher, which are considered to be outstanding.<sup>6</sup>

The designation of periodontal status was based on clinical findings that may be associated with systemic effects including those that may negatively impact obstetric outcomes. For our analysis, periodontal status at enrollment was dichotomized as healthy/mild periodontal disease (<15 sites, PD  $\geq$ 4 mm), or moderate/severe (15 or more sites, PD  $\geq$ 4mm). Moderate/severe periodontal disease was considered a possible predictor or exposure variable for negative obstetric outcomes and for systemic inflammation. In addition the contribution of third molar periodontal pathology alone, the upper quartile of the extent of PD for third molars (PD  $\geq$ 4mm), also was considered as a possible predictor for these same outcomes.

The primary outcome variable for a negative obstetric outcome was preterm birth, gestational age less than 37 weeks. The primary outcome variables for a systemic response to oral inflammation at enrollment



**FIGURE 1.** Examiner reliability. Intraclass correlations (ICC), % agreement, and  $\kappa$  scores for non-third molars ( $n = 11,178$ ) and third molar ( $n = 304$ ) sites. Examiner reliability was very good for both attachment loss (AL) and pocket depth (PD) measures for third molar measurements and non-third molar measurements.

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were elevated serum levels of CRP and d8iso, the upper quartile of serum levels of these markers of systemic inflammation for the study population.

Simple descriptive statistics were used to generate tables for demographic, oral health, and obstetric outcomes. Chi-square and  $t$  tests were used to determine statistical significance set at 0.05. Predictor variables found to be significant on bivariate analysis, including those for moderate/severe periodontal disease, were included in multivariate models. Unconditional logistic multivariate models were used to derive odds ratio (OR) and 95% confidence interval (CI). Data were analyzed using SAS (version 9.1; SAS, Research Triangle Park, NC).

## Results

### EXAMINER RELIABILITY FOR THIRD MOLARS

The calibration sessions included 41 patients involving 304 third molar probing sites and 11,178 non-third molar probing sites. For the 15 trained examiners involved, reliability of PD within 1 mm was similar for third molars and non-third molars, 90.8% agreement ( $\kappa = 0.89$ ) and 92.0% agreement ( $\kappa = 0.90$ ), respectively (Fig 1). Perfect agreement was also similar for third molars and non-third molars, 45.4% agreement ( $\kappa = 0.33$ ) and 49.0% agreement ( $\kappa = 0.35$ ). Results were similar for attachment loss (AL) (Fig 1).

### INCLUSION OF THIRD MOLARS AND SYSTEMIC RESPONSE

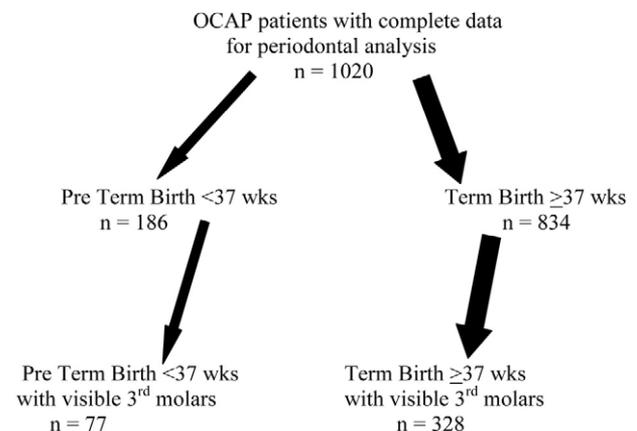
The flow of obstetric patients with periodontal data included in our analyses from the OCAP prospective study is displayed in Figure 2. Data from 1,020 obstet-

ric patients enrolled between December 1997 and July 2001 were available for analysis. Eighteen percent of the patients delivered preterm ( $<37$  weeks). The characteristics of the OCAP patients analyzed for this study are displayed by term and preterm delivery in Table 1. At least 1 third molar was visible clinically in 405 OCAP patients; 19% delivered preterm ( $<37$  weeks) (Table 2).

Significant differences for preterm birth in the entire OCAP population were found for age, ethnic origin, marital status, Women and Infant Care services (WIC) or food stamp eligibility, medical insurance, previous preterm delivery, and chorioamnionitis (Table 1). Although the data are not shown, alcohol or recreational drug use during pregnancy, maternal weight, first pregnancy, any sexually transmitted disease, or having bacterial vaginosis treatment were not associated significantly with preterm birth.

If only the patients with third molars visible were studied with bivariate analysis, significant differences were found for ethnic origin, smoking, medical insurance, previous preterm delivery, and chorioamnionitis (Table 2).

For the 1,020 obstetric patients in the OCAP study, bivariate analyses showed that having moderate/severe periodontal disease at enrollment as determined by PD excluding third molars was significantly associated with preterm birth, gestational age less than 37 weeks ( $P = .008$ ). Including periodontal PD greater than or equal to 4 mm for third molars in the analysis also was significantly associated with preterm birth ( $P = .0005$ ) (Table 1). The same significant relationships were found for the bivariate analysis of the 405 OCAP patients who had visible third molars ( $P = .004$  and  $P = .0006$ , respectively) (Table 2). However, these associations do not account for other factors that may be potential confounders of the association.



**FIGURE 2.** Flow of patients with periodontal probing data enrolled in "Oral Conditions and Pregnancy" (OCAP) from enrollment to analysis.

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**Table 1. ENROLLMENT CHARACTERISTICS OF OCAP SUBJECTS WHO EXPERIENCED PRETERM DELIVERY\***

Variable	Preterm Delivery		P-value
	No 834 (81.8)	Yes 186 (18.2)	
Maternal age (years, mean $\pm$ SD)	28.5 (6.7)	26.7 (6.0)	.0004
African American	346 (73.5)	125 (26.5)	
Caucasian	436 (89.5)	51 (10.5)	
Other race	52 (83.9)	10 (16.1)	<.0001
Smoke during pregnancy	124 (76.5)	38 (23.5)	
Did not smoke	710 (82.8)	148 (17.3)	NS
Not married	388 (78.1)	109 (21.9)	
Married	446 (85.3)	77 (14.7)	.003
WIC or food stamp eligibility	141 (76.6)	43 (23.4)	
No WIC or food stamp eligibility	693 (82.9)	143 (17.1)	<.05
No medical insurance	418 (78.0)	118 (22.0)	
Medical insurance	416 (86.0)	68 (14.1)	.001
Previous preterm delivery	88 (66.2)	45 (33.8)	
No previous preterm delivery	746 (84.1)	141 (15.9)	<.0001
Chorioamniotitis	3 (23.1)	10 (76.9)	
No chorioamniotitis	831 (82.5)	176 (17.5)	<.0001
15+ sites w/PD $\geq$ 4mm (excluding third molars)	97 (73.5)	35 (26.5)	
<15 sites w/PD $\geq$ 4mm (excluding third molars)	737 (83.0)	151 (17.0)	.008
15+ sites w/PD $\geq$ 4mm (including third molars)	105 (71.4)	42 (28.5)	
<15 sites w/PD $\geq$ 4mm (including third molars)	729 (83.5)	144 (16.5)	.0005

\*Values are *n* (%). Preterm delivery means a gestational age <37 weeks (N = 1,020).

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Smoking during pregnancy was not a significant predictor of preterm birth in the bivariate analysis of the entire OCAP population, though it was significant for OCAP patients with third molars (Tables 1, 2).

Smoking was included in our multivariate models as a control variable because of the known positive relationship between smoking and periodontal disease, and smoking with obstetric outcomes. For our multi-

**Table 2. ENROLLMENT CHARACTERISTICS OF OCAP SUBJECTS WITH THIRD MOLARS WHO EXPERIENCED PRETERM DELIVERY\***

Variable	Preterm Delivery		P-value
	No 328 (81.0)	Yes 77 (19.0)	
Maternal age (years, mean $\pm$ SD)	27.7 (6.3)	26.5 (6.1)	NS
African American	197 (74.9)	66 (25.1)	
Caucasian	105 (95.5)	5 (4.5)	
Other race	26 (81.3)	6 (18.7)	<.0001
Smoke during pregnancy	59 (71.1)	24 (28.9)	
Did not smoke	269 (83.5)	53 (16.5)	.01
Not married	199 (78.4)	55 (21.6)	
Married	129 (85.4)	22 (14.6)	NS
WIC or food stamp eligibility	73 (75.3)	24 (24.7)	
No WIC or food stamp eligibility	255 (82.8)	53 (17.2)	NS
No medical insurance	211 (79.0)	56 (21.0)	
Medical insurance	117 (84.8)	21 (15.2)	.001
Previous preterm delivery	46 (70.8)	19 (29.2)	
No previous preterm delivery	282 (82.9)	58 (17.1)	.02
Chorioamniotitis	2 (28.6)	5 (71.4)	
No chorioamniotitis	326 (81.9)	72 (18.1)	<.001
75 percentile sites w/PD $\geq$ 4mm (excluding third molars)	72 (71.3)	29 (28.7)	
<75 percentile sites w/PD $\geq$ 4mm (excluding third molars)	256 (84.2)	48 (15.8)	.004
75th percentile extent third molar w/PD $\geq$ 4mm	70 (69.3)	31 (30.7)	
<75th percentile extent third molar w/PD $\geq$ 4mm	258 (84.9)	46 (15.1)	.0006

\*Values are *n* (%). Preterm delivery means gestational age <37 weeks (n = 405).

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**Table 3. LOGISTIC REGRESSION MODEL OF PERIODONTAL DISEASE AND PRETERM DELIVERY\***

Variable	Odds Ratio (lcl-uc)
75th percentile extent PD $\geq$ 4mm (third molars)	2.4 (1.1-5.2)
75th percentile extent PD $\geq$ 4 mm (non third molars)	1.0 (0.5-2.2)
Maternal race (non-Caucasian)	7.1 (2.6-19.6)
Maternal age (5 year increment)	0.8 (0.7-1.1)
Smoke during pregnancy (yes)	2.0 (1.1-3.8)
Previous preterm delivery (yes)	1.6 (0.9-3.1)
Chorioamnionitis (yes)	18.9 (2.7-134.4)
Not married	1.2 (0.6-2.3)
Lack medical insurance	1.4 (0.7-2.8)
WIC or food stamps eligible (yes)	1.2 (0.6-2.2)

\*Subjects with third molars only (n = 405).

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variate models maternal race was dichotomized to African American or non-African American because of the small number of patients in the "other" category.

When other factors were controlled in multivariable analyses of the entire OCAP population, having moderate/severe periodontal disease at enrollment, PD greater than or equal to 4 mm *excluding third molar teeth*, was not significantly related to preterm birth (OR, 1.4; 95% CI, 0.9, 2.3). However, by including third molar PD greater than or equal to 4 mm in the analyses, moderate/severe periodontal disease at enrollment was significantly associated with preterm birth, gestational age less than 37 weeks (OR, 1.7; 95% CI, 1.1, 2.6). These models are not displayed.

If third molar PD alone at enrollment was considered as a predictor in a multivariate model of OCAP patients with third molars, for patients in the upper quartile of extent of third molar PD greater than or equal to 4 mm, odds were increased for preterm birth (OR, 2.4; 95% CI, 1.1, 5.2) (Table 3). If *third molars were excluded* in this model, odds of preterm birth were not increased (OR, 1.0; 95% CI, 0.5, 2.2) (Table 3).

The importance of including the periodontal assessments around third molars as possible exposures for systemic inflammatory or infectious oxidative stress is further demonstrated by analyses of the association between periodontal disease and serum levels of CRP and d8iso. CRP is a marker of the acute phase inflammatory response, and d8iso is a marker of oxidative stress.

Controlling for other factors with multivariate models (not displayed), moderate/severe periodontal disease at enrollment was associated with elevated serum CRP levels, of at least 15.7 mg/l that is the lower limit of the upper quartile of serum CRP levels for the OCAP study patients. If moderate/severe periodontal

disease was detected at enrollment including third molars, odds were increased for elevated serum CRP at enrollment (OR, 1.9; 95% CI, 1.2, 3.0). Considering third molar PD alone at enrollment as a predictor, for patients in the upper quartile of extent of third molar PD greater than or equal to 4 mm, odds were increased for elevated serum CRP at enrollment (OR, 2.3; 95% CI, 1.3, 4.3).

Controlling for other factors with multivariate models (not displayed), moderate/severe periodontal disease at enrollment also was associated with elevated serum d8iso levels, the upper quartile of serum d8iso levels for the OCAP study patients. If moderate/severe periodontal disease was detected at enrollment including third molars, odds were increased for elevated serum d8iso at enrollment (OR, 2.7; 95% CI, 1.8, 4.2). If third molar PD alone at enrollment was considered as a predictor, for patients in the upper quartile of extent of third molar PD greater than or equal to 4 mm, odds also were increased for elevated serum d8iso at enrollment (OR, 3.4; 95% CI, 1.9, 6.1).

## Discussion

A principal finding from these analyses was that clinical periodontal measures could be reliably assessed on visible third molars by trained examiners. Poor examiner reliability is not a valid reason to exclude third molars in an assessment of periodontal pathology and oral inflammation.

In an analysis of the incidence and progression of periodontal disease over the course of pregnancy in the OCAP patients, Moss et al<sup>7</sup> found that increased PD was more likely at the interproximal probing sites of molar teeth. The data we report here suggest that periodontal pathology affecting third molars, as assessed by PD greater than or equal to 4 mm, contributed substantially to the increased level of oral inflammation found in the OCAP patients and to the systemic impact of the oral inflammation.

The data of Blakey et al<sup>3</sup> on patients in the third decade of age with 4 asymptomatic third molars led us to expect that this might be the case. Asymptomatic periodontal pathology, PD greater than or equal to 5 mm, was detected often in the third molar region in Blakey's patients, specifically the periodontal supporting tissue on the distal of second molars and around third molars. Only 4 of Blakey's 329 patients had a PD greater than or equal to 5 mm on probing sites for teeth more anterior in the mouth. Blakey et al pointed out that the prevalence of periodontal disease would be much higher in patients 25 to 34 years old in the US population if mandibular third molars were included in NHANES III analysis, 5% versus 32%.<sup>3</sup> For these same patients who were considered periodontally healthy if third molars were ignored, White et al

reported high levels of “orange and red complex” periodontal pathogens and increased GCF IL-1 $\beta$  levels in the third molar region.<sup>4,5</sup>

Additional data addressing third molars and periodontal pathology from populations other than those studied by Blakey et al<sup>3</sup> add weight to our conclusions about the contribution of third molar periodontal pathology to periodontal disease prevalence. Elter et al<sup>6</sup> analyzed periodontal data from persons 18 to 34 years of age included in the National Health and Nutrition Estimates Survey (NHANES) III database. PD for third molars was not a part of the NHANES III protocol. However, if a third molar was visible, a PD greater than or equal to 5 mm was more likely for teeth more anterior in the quadrant.<sup>8</sup> Data were obtained between 1996 and 1999 on 6,793 persons aged 52 to 74 from the Dental ARIC Study, a sub-study of the Atherosclerosis Risk in Communities Study.<sup>9</sup> The main independent variable was presence or absence of third molars assessed visually, and the dependent variable was an assessment of periodontal disease as measured by PD at least 5 mm. A visible third molar was associated with 1.5 times the odds of a PD at least 5 mm on the adjacent second molar, while controlling for other factors associated with presence of third molars and periodontal disease. We believe it is prudent to suggest that third molars should be included in any assessment of the level of oral inflammation with periodontal pathology.

Offenbacher has recently summarized the pathobiology of oral infectious diseases, caries and periodontitis, and the role of oral inflammation with periodontal pathology as a stressor impacting negative obstetric outcomes; preterm birth less than 37 weeks and low birth weight less than 2.5 kg.<sup>10</sup> Data from animal studies and clinical data were reviewed. Although no animal model mimics preterm birth in humans, pregnant mice chronically challenged with “red complex” pathogenic bacteria showed signs of placental inflammation and produced growth restricted offspring.<sup>10</sup> Offenbacher commented that these animal data offer “proof of concept” evidence that anatomically distant, chronic oral inflammation may affect the developing human fetus in a manner similar to more proximal anatomic exposure with genitourinary tract inflammation.<sup>10</sup>

Madianos et al<sup>11</sup> reported interim study data at term, from the OCAP population we studied at enrollment. Maternal IgG does not cross the placenta. Fetal IgM seropositivity to “orange and red” complex oral pathogens from cord blood at term was significantly higher, almost 3-fold, for preterm infants. The high degree of fetal antibody seropositivity at term to oral organisms is highly suggestive of fetal exposure to maternal oral pathogens during pregnancy. Just as important was Madianos’ finding that for preterm

infants, maternal seropositivity to “orange and red” complex oral pathogens was inversely related to fetal IgM in cord blood. A protective maternal serum antibody response to periodontal pathogens could protect the fetus from exposure and the possible negative outcome of preterm birth.

In our analyses of OCAP patients with clinical evidence of higher levels of oral inflammation, third molar PD greater than or equal to 4 mm contributed substantially to the overall oral inflammatory burden of periodontal pathology and a negative health outcome, preterm birth (Table 2). As Offenbacher comments in his review, preterm birth affects almost 10% of the half million infants born each year in the United States.<sup>10</sup> The incidence of this obstetric outcome has not been reduced over the last few decades, despite advances in health care and increased interventions targeting populations thought to be at risk. Based on our data and the evidence that continues to emerge, it is plausible to include oral inflammation and more specifically periodontal pathology affecting third molars with the attendant high level of “orange” and “red” complex Gram negative bacteria in the oral biofilm, as an unrecognized, anatomically distant, systemic exposure that can negatively impact obstetric outcomes.

Our data supports an association between oral inflammation affecting third molars alone and preterm birth in obstetric patients (Table 3). The data add weight to Blakey et al’s findings that periodontal pathology, found more often affecting third molars than other teeth in younger patients, plays a clinically important role in the level of oral inflammation in younger patients.<sup>3</sup>

Our findings of an association between periodontal disease affecting third molars and elevated serum markers of systemic inflammation, specifically elevated CRP and d8iso, are consistent with chronic oral inflammation, as a systemic exposure resulting in a systemic response. In these younger obstetric patients, third molar periodontal pathology alone contributed substantially to the level of systemic inflammation found at enrollment to the study.

Serum CRP levels, generated mostly by hepatocytes, are accepted as systemic markers of the duration and intensity of tissue injury and inflammation.<sup>12</sup> At enrollment, those in OCAP enrolled in the mid-trimester of pregnancy and in the upper quartile of extent of PD greater than or equal to 4 mm affecting third molars, had twice the risk of increased systemic inflammation as indicated by the upper quartile of serum CRP levels, greater than 15 mg/l.

Periodontal pathology affecting third molars was associated with higher serum levels of Isoprostanes, a more recently studied marker of a systemic response. Isoprostanes are one of a number of markers newly being investigated to characterize the oxidative stress component of systemic conditions. The F2-isopros-

tanases in general and 8-isoPGF<sub>2α</sub> (d8iso) in particular have been studied more thoroughly. These prostaglandin like compounds are derived principally by non-enzymatic free-radical induced lipid peroxidation.<sup>13-15</sup> Independent of cyclooxygenase, d8iso is generated initially at the site of a free radical attack of arachidonate in cell membranes. Elevated d8iso serum levels serve as markers of low-grade inflammation, increased oxidative stress and lipid peroxidation. Levels of serum d8iso, assessed currently by immunoassay, have been found elevated in disease states characterized by chronic inflammation including cigarette smoking, diabetes mellitus, and with other cardiovascular risk factors such as high serum LDL and cholesterol levels. Studies of d8iso as a marker of inflammation and oxidative stress in pregnancy are limited.<sup>16</sup> In our study patients at enrollment, the extent of PD greater than or equal to 4 mm with third molars was associated with the upper quartile of serum d8iso levels.

Further study of third molar periodontal pathology with other populations of patients are needed to corroborate our findings. For example, Blakey et al<sup>17</sup> documented that patients presenting with acute pericoronitis had clinical and laboratory evidence of oral inflammation; pain, exudate, and elevated levels of “orange” complex bacteria and GCF IL-1β in the third molar region. Pericoronitis, a severe gingivitis, may or may not be accompanied by systemic inflammation and its accompanying detrimental systemic health risks. If our findings are substantiated, once third molar periodontal pathology is discovered clinically, the condition though asymptomatic may require more urgent treatment than is usually recommended today.

Our obstetric study population was derived from patients treated at a university medical center. About half the patients treated at this university center were referred because of higher obstetric risk. Thus, our study population consisted of a higher risk group of obstetric patients.<sup>6</sup> Almost 20% of OCAP patients delivered preterm, more than twice the estimated risk for the US population overall. Thirteen percent of the 1,020 OCAP patients had moderate/severe periodontitis at enrollment, a much higher level of oral inflammation than would be expected for individuals in this age group. The increased odds we report here for obstetric outcomes might not be applicable to all pregnant patients and certainly should not be applied to an individual patient. However, all women of child-bearing age, their dentists, and physicians should be aware of the systemic risks from oral inflammation with periodontal pathology. A clinical assessment for periodontal pathology including third molars should

be included in any assessment of overall oral health for women planning pregnancy.

Dental examiners could reliably assess clinical periodontal measures on third molars. Poor examiner reliability is not a valid reason to exclude third molars in an assessment of periodontal pathology and oral inflammation.

Third molars should be included in studies of systemic outcomes associated with oral inflammation.

Women of child-bearing age should be made aware of the systemic risks of chronic oral inflammation with periodontal pathology with specific attention paid to the periodontal health of third molars.

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