Maternal Periodontitis and its Relation with Preterm Gestation: A Clinical and Case-control Study

Vinath Reddy Kankara1, V Viswanath2, P Pranitha3, Yasangi Manoj Kumar4, Dhanalakshmi Mannem4, Devi Ganji5

Contributors:
1Reader, Department of Periodontics, Sri Sai College of Dental Surgery, Vikarabad, Hyderabad, Telangana, India; 2Professor, Department of Public Health Dentistry, sibar Institute of Dental Sciences., Guntur, Andhra Pradesh, India; 3Senior Lecturer, Department of Periodontics, Sree Sai Dental College and Research Institute, Sriakulam, Andhra Pradesh, India; 4Reader, Department of Prosthodontics, Priyadharshini Dental College and Hospital, Thiruvallur, Tamil Nadu, India; 5Post Graduate, Department of Prosthodontics, C.K.S Theja Dental College, Tirupathi, Andhra Pradesh, India.

How to cite the article:

Abstract:
Background: Why maternal periodontitis may induce an inflammatory response with a preterm pregnancy is unclear? This study was done to assess if periodontitis can predict preterm gestation.

Aim: The aim of this study was to assess if periodontitis can predict preterm gestation.

Materials and Methods: Clinical parameters such as pocket depth/sulcus depth and Russel’s periodontal indices were recorded from 36 subjects. They were divided into two groups based on the parameters such as gestational age (GA) above or below 36 weeks and periodontal pocket depth beyond 5 mm.

Results: A positive correlation was found between GA, Russel’s periodontal index, and pocket depth (r = −0.69, P < 0.001), (r = −0.71, P < 0.001), i.e., when pocket depth is more than 4 mm; there was increase in Russel’s periodontal index score, estimated GA shows a steady decline.

Conclusion: With increase Russel’s periodontal index score and periodontal destruction, there is increase of inverse relationship to premature gestation.

Key Words: Chronic periodontitis, pocket/sulcus depth, preterm gestational age, Russel’s periodontal index

Introduction
Periodontal disease is a common chronic inflammatory process characterized by bacterial challenge and release of various toxic products by periodontal pathogens and by host immune response. Preterm birth and intrauterine growth restriction are major predictors of perinatal mortality and morbidity. A number of studies demonstrated an association between infection and preterm low birth weight (PLBW).1 Convincing evidence has associated preterm birth with infection, especially genitourinary infections which appear to be an important factor in the premature rupture of membranes. Several studies have linked with bacterial vaginosis and preterm birth. However, the treatment of vaginosis has not led to definite conclusions on its efficacy in reducing preterm delivery and impact of such intervention on preterm birth rate remains unclear. Researchers have however noticed that a consistent and reproducible feature of PLBW cases is increased levels of inflammatory products such as prostaglandin E2 and tumor necrosis factor-alpha (TNF-α) even in the absence of clinical and subclinical infections of genitorurinary tract.2 Results of 2 case control studies and concurrent cohort study showed that maternal periodontal disease may be a potential independent risk factor for PLBW considering this as one of the subclinical infections among several risk factors.2-10

The pathological mechanism by which chronic periodontitis may cause or exacerbate, an inflammatory response resulting in premature termination of pregnancy remains unclear. There is also certain evidence that patients with untreated periodontitis are at greater risk for bacteremia. “Periodontitis is defined as a chronic inflammatory multifactorial disease of the periodontal tissues surrounding the teeth.” It has been postulated that periodontal infection may cause bacteremia predominantly Gram-negative, anaerobic and microaerophilic bacteria. These bacteria release the circulation of endotoxins such as lipopolysaccharides, hydrolytic enzymes, and peptidoglycans which trigger host immune response resulting in low-grade inflammation of other organs. Pro-inflammatory cytokines and chemokines, (e.g.: TNF-α, interleukin-1, 8) are involved in preterm labor.3

The concept that systemic health is influenced by periodontal disease is not new. Miller originally published his “focal infection theory” in 1891. In his theory, he suggested that endotoxins released from microorganisms or their waste products enter to systemic body parts either through blood stream or remote from the mouth.3 Miller and subsequent proponents of the focal infection theory hypothesised that oral foci of infection for a number of regional and systemic diseases, ranging from septicemia, tonsillitis, tuberculosis, syphilis middle ear infection, pneumonia, osteomyelitis,
Infective endocarditis, meningitis etc. Before the development of modern periodontal treatments, many teeth were extracted prophylactically because of focal infection theory.\textsuperscript{12,13}

According to recent advances in identification, culturing and characterization of periodontal pathogens as well as their potential mechanisms of action of their bacterial products and inflammatory cytokines.\textsuperscript{11} They have paved a way for a more realistic assessment and correlation of systemic importance and periodontal disease. Epidemiological, microbiological and immunological studies have showed a new pathway to the concept that cardiovascular disease, cerebrovascular disease, and respiratory disease as well as preterm delivery of LBW infants are influenced by periodontal disease and it may considered a separate risk factor for above mentioned systemic diseases.\textsuperscript{12,13}

This study is undertaken to assess association between periodontitis and premature gestation.

Aims and objectives
To know if periodontitis can predict premature gestation.

Materials and Methods
A cross-sectional case-controlled study was designed and conducted at Government Maternity Hospital. The total number of subjects was determined, based on the discussions held with a biostatistician, keeping informed about the various parameters and the groups involved in the study. The study included 36 subjects in an age group of 19-35 years with pregnancy that was distributed into two groups. Informed consent was obtained from all subjects verbally as well as written before their enrollment in the study. Before the study, this project was reviewed by the board of Ethical Committee of the Dental College and clearance was obtained. Participation of the subjects in this study did not affect any treatment decisions regarding their medical care. The subjects were divided into two groups 18 of each.

- Group I: 18 subjects without periodontitis and term gestation (Figure 1)
- Group II: 18 subjects with periodontitis and preterm gestation (Figures 2 and 3).

The following criteria were included in the study. Based on periodontal condition subjects were divided as Group I without periodontitis, probing pocket depth <3 mm.\textsuperscript{3} Group II with periodontitis, probing pocket depth of >5 mm in each quadrant.\textsuperscript{3} Based on pregnancy criteria subjects were divided as Group I gestation age >36 weeks.\textsuperscript{3} Group II, gestation age <36 weeks.

The pregnant women who were having diabetes, hypertension, epilepsy, vaginal infections, smoking, alcoholic, under any medication, Tobacco chewing, etc. were excluded from the study.\textsuperscript{3} A through medical and dental history was taken in detailed of each patient in the prepared proforma enclosed. The periodontal examination was carried out with mouth mirrors, Williams graduated periodontal probe under natural illumination.

![Figure 1: Group I patient.](image1)

![Figure 2: Group II patient.](image2)

![Figure 3: Group II patient with more than 5 mm of pocket depth.](image3)
Statistical analysis

All the values were expressed in the form of mean, standard deviation (SD). The results were averaged (mean ± SD) for each parameter is presented in Tables 1-4 and Graphs 1-6. The parameters were compared between the two groups using Student’s t-test, Kruskal–Wallis test Pearson r correlation.

Results

This was a case-control study, where subjects were selected at random and categorized into two groups from 36 patients.

- Group I: 18 subjects with term gestation without chronic periodontitis (Table 1)
- Group II: 18 subjects with preterm gestation and chronic periodontitis (Table 1).

Clinical parameters

Clinical parameters such as pocket depth, Russel’s index were recorded for all 36 subjects and were included for statistical analysis.

Age

The mean Sulcus depth in Group I was 22.50 years with SD 1.75 (Table 1 and Graph 1). The mean pocket depth in Group II was 22.39 years with SD 2.63 (Table 1 and Graph 1).

Gestational age (GA)

The mean GA of Group I was 38.72 weeks with SD 1.44 (Table 2 and Graph 1). The mean GA of Group II was

The mean age was compared in Groups I and II. The mean age was significantly higher in Group I, i.e., 22.50; SD ±1.75 (Table 1, Graph 1), when compared with Group II, i.e., 22.39; SD ± 2.63 (Table 1 and Graph 1) which was statistically not significant (t = 0.14; P = 0.88).

The mean age of control group (22.50 years) is slightly higher than that of the experimental group (22.39) the difference of which was not statistically significant.

Gestational age (GA)

The mean GA of Group I was 38.72 weeks with SD 1.44 (Table 2 and Graph 1). The mean GA of Group II was

Table 1: Mean age (years) of Group II and Group I.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of subjects</th>
<th>Mean±SD</th>
<th>t value</th>
<th>P</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>18</td>
<td>22.39±2.63</td>
<td>0.14</td>
<td>0.88</td>
<td>NS</td>
</tr>
<tr>
<td>Group I</td>
<td>18</td>
<td>22.50±1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>22.44±2.20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NS: Non-significance, SD: Standard deviation

Table 2: Mean Gestational age (in weeks) of Group II and Group I.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of subjects</th>
<th>Mean±SD</th>
<th>t value</th>
<th>P</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>18</td>
<td>33.33±1.78</td>
<td>9.95</td>
<td>&lt;0.001</td>
<td>S</td>
</tr>
<tr>
<td>Group I</td>
<td>18</td>
<td>38.72±1.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>36.02±3.16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NS: Non-significance, SD: Standard deviation

Table 3: Mean Russel’s index score of Group II and Group I.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of subjects</th>
<th>Mean±SD</th>
<th>t value</th>
<th>P</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>18</td>
<td>3.37±1.43</td>
<td>8.39</td>
<td>&lt;0.001</td>
<td>S</td>
</tr>
<tr>
<td>Group I</td>
<td>18</td>
<td>0.53±0.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>2.23±1.53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NS: Non-significance, SD: Standard deviation

Table 4: Mean pocket (sulcus) depth of Group II and Group I.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of subjects</th>
<th>Mean±SD</th>
<th>t value</th>
<th>P</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>18</td>
<td>6.05±1.69</td>
<td>9.30</td>
<td>&lt;0.001</td>
<td>S</td>
</tr>
<tr>
<td>Group I</td>
<td>18</td>
<td>2.16±0.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>4.11±2.32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NS: Non-significance, SD: Standard deviation

Graph 1: Age and gestational age of study and control groups.

Graph 2: Mean Russel’s index and sulcus depth of study and control group.

Graph 3: Mean pocket depth in Groups II and I.
The mean GA of the Group II is considerably found to be lesser (33.33 weeks) compared to that of the Group I (38.72 weeks) and the difference was also found to be statistically significant.

Pocket depth
The mean sulcus depth of Group I was 2.16 mm with SD 0.51 (Table 4 and Graph 3). The mean pocket depth of Group II was 6.05 mm with SD 1.69 (Table 4 and Graph 3).

The mean pocket depths (Sulcus depth) were compared in Groups I and II. The mean pocket depth was significantly lower in Group I, i.e., 2.16 mm; SD ± 0.51 (Table 4 and Graph 3) when compared to Group II, i.e., 6.05 mm; SD ± 1.69 (Table 4 and Graph 3), which was statistically significant ($t = -15.21; P < 0.001$, Table 4).

Russel's periodontal index
The mean Russel’s periodontal index score of Group I was 0.53 with SD of 0.19 (Table 3 and Graph 2). The mean Russel’s periodontal index score of Group II was 3.37 with SD of 1.43. (Table 3 and Graph 2).

The mean Russel’s periodontal index scores were compared. The mean Russel’s index score was significantly higher in Group II, i.e., 3.37 ± 1.43 when compared to Group I, i.e., 0.53 ± 0.19, which was statistically significant (Table 3 and Graph 2) ($t = 8.39; P < 0.001$).

The mean Russel’s Index score of the Group II is considerably found to be higher (3.37) compared to that of the Group I (0.53) and the difference was also found to be statistically significant.

Linear regression analysis
Graph 4 shows that the estimated GA falls with the increase in the Russel's Index score. When the Russel’s index scores increase beyond around 0.81, the GA falls below premature level of 36 weeks gestation. Thus, one can infer that a Russel’s index score of more than 0.81 predicts prematurity.

Graph 5 shows that with increase in pocket/sulcus depth, the estimated GA shows a steady decline of it. A level of 5 mm or above pocket/sulcus depth indicates a GA of <36 weeks (prematurity).

Graph 6 shows that with the simultaneously increase in estimated pocket depth of 5 mm and Russel’s index score of beyond 0.81 shows prematurity of 36 weeks gestation.

Discussion
Periodontitis is a multifactorial infection that affects the tooth supporting tissues and it is considered as a continuous inflammatory and pathogenic challenge at a systemic level,
due to ulceration of epithelium surface of the periodontal pockets, which leads into systemic circulation. Due to this fact allows bacteria and their end products reach other parts of the organism, creating lesions at different levels.

On the basis of above evidence, this study was undertaken to determine the influence of periodontitis in pregnant women. This study is based on hypothesis that periodontitis, an infectious process itself, may be related to premature GA. Different studies on the association between periodontitis and PLBW have used different criteria for the definition of periodontitis. Therefore, in this study Russel’s periodontal index score and probing pocket depth of at least two sites with a probing depth ≥ 5.0 mm were taken into consideration for the diagnosis of periodontalitis. These results are in agreement with Bogges et al., Lin et al., and Casey et al.

Bogges et al. suggested when focus is exposed to periodontal bacteria and an inflammatory response is generated, the prematurity risk may increase. The authors analyzed the umbilical cord blood of 640 newborns and measured TNF-α levels. It was found that the preterm birth rate was significantly higher if umbilical blood was IgM positive versus IgM negative and TNF-α was categorized as high versus low (23% vs. 5% P < 0.001 and 10% vs. 4% P < 0.01, respectively).

As per the results of Lin et al., it was found that the concentration of TNF-α was increased in maternal serum mice infected with Porphyromonas gingivalis, with a significant increase in dams with fetal growth restriction (FGR) fetuses (i.e., PG + FGR, 27.50 ± 8.16) compared to levels in the mice having normal fetuses (i.e., PG-NFW 2.91 ± 2.01, PG-NFW 6.64 ± 2.64 (P < 0.05), which was statistically significant.

In this study, Mean Russel’s periodontal index score were higher in Group II than Group I (t = 8.31, P < 0.001), and Mean pocket depth was higher in Group II than Group I (t = −15.21, P < 0.001). A positive correlation was found between pocket depth and GA (r = −0.69, P < 0.001), i.e., when pocket depth increase beyond 4 mm or above estimated GA shows a steady decline. A positive correlation was also found in between Russel’s index score and GA (r = −0.71, P < 0.001), i.e., when the Russel’s index increases, the GA falls below prematurity levels of gestation. These results are in accordance with Romero et al., Radnai et al. (2004) and Moss et al.

According to the correlation analysis of Romero et al., there was highly significant clinical relationship between more severe periodontal disease and LBW (r = −0.49; P < 0.01), a highly significant relationship was demonstrated between increasing periodontal severity and decreasing GA of the newborn babies (r = −0.59; P < 0.01). This suggested that periodontal disease in pregnant women could be a clinically significant risk factor for preterm delivery.

As per the results of Moss et al., it was found that probing depths ≥ 4 mm were the most important periodontal parameters which correlated with preterm birth in the group of pregnant women (P = 0.001 or 3.76) univariate analysis. It is not surprising to find that increasing maternal periodontal disease severity may result in decreasing birth weight and preterm GA. Studies carried out in hamsters have demonstrated that an increase in PD severity during pregnancy is associated with the risk of premature birth and LBW.

**Conclusion**

Maternal periodontitis is a Gram-negative infection which has the potential to influence on pregnancy. During the second trimester of pregnancy, the proportion of Gram-negative anaerobic bacteria in dental plaque increases with respect to aerobic bacteria and their end products were found in the amniotic fluid of women with preterm births. A number of multicenter, randomized, controlled clinical trials required to confirm this link between maternal periodontitis, and preterm gestation. With this study, we can conclude that there is always relation between maternal periodontitis and preterm gestation, which can be considered one among the causes of preterm gestation.

**References**


