

Gingival Tissue and Pregnancy

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1. Introduction

During pregnancy, many changes take place in both systemic and local environments leading to a significant increase in the severity of gingivitis. In recent years, many studies have assessed the changes that occur within the gingival tissue during pregnancy and their potential impact on the foetus.

Pregnancy is defined as a state that includes fertilization, implantation and embryonic and fetal growth that ends with the birth of a baby after 280 days or 40 weeks. Pregnancy gingivitis presents as gingival erythema, enlargement and bleeding. Epidemiological studies have shown that the prevalence of gingivitis increases during pregnancy when compared to control groups. The evidence indicates that hormonal changes affect the rate of cell turnover of the gingival tissues, inducing several microbiological changes in the subgingival flora and immunosuppression of the immune system.

New evidence supports an association between the periodontal status and complications during pregnancy. Some countries have developed policies and practice guidelines that recommend oral care and the control of inflammation of the periodontal tissues throughout pregnancy.

This chapter will review the effect of pregnancy on gingival status and the potential impact of gingival inflammation on the unborn child.

2. Pregnancy gingivitis

Pregnancy is accompanied by an increase in the production of estrogen and progesterone. Initially, the ratio of estrogen and progesterone is 100:1 but during the final months this changes to 1:1. Following birth the hormones reach their normal levels within 2 to 3 days (Mariotti 1994, Laine 2002).

Two theories have been proposed for the actions of the hormones on the cells of the periodontal tissues: 1) a change in the effectiveness of the epithelial barrier to bacterial insult and 2) an effect on collagen turnover (Markou *et al.* 2009). There are several receptors for estrogen and progesterone within the gingival tissue. The estrogen receptors (ERs) exist as two subtypes: ERalpha and ERbeta. ERbeta is widely expressed at high levels in oral tissues (Välimaa *et al.* 2004). ERbeta is involved in important physiological processes, such as cell differentiation, extracellular matrix organization and stromal-epithelial communication

(Morani *et al.* 2008). Estrogen firstly decreases collagen production and keratinization of gingival epithelium and secondly induces proliferation of fibroblasts and decreases the collagen and no collagen proteins, blocks the turnover of the gingival tissue, thereby reducing the capacity of gingival tissue to repair. The result is an increase in the permeability of the epithelial barrier and an increased response to plaque bacteria. (Markou *et al.* 2009). Liu *et al.* (1999) observed a decrease in cellular proliferation of the periodontal ligament (PDL). In addition, a decrease in the rate of collagen is mediated by ERbeta. In contrast, no immunoreactivity was expressed in these cells for progesterone receptors, implying that progesterone does not have a direct effect on the function of PDL cells (Jönsson 2007).

The reactivity for progesterone receptors was observed in gingival fibroblasts (Kawahara & Shimazu 2003). Progesterone also has effects on the vascular system favoring an increase in gingival exudate and vascular permeability and proliferation; this is possibly due to progesterone receptors present in the gingival tissue (Markou *et al.* 2009). Other factors associated with the tissue changes during pregnancy are those related to the fibrinolytic system. Fibroblast and macrophages from gingival tissue produce plasminogen activator inhibitor type-2 (PAI-2). Several studies had suggested a hormonal influence on the PAI-2 that disturbs the balance of the fibrinolytic system. A lower inhibitory capacity in terms of a low production of PAI-2 associated with progesterone during pregnancy in women with a higher inflammatory reaction has been observed and could contribute to gingivitis during pregnancy (Kinnby *et al.* 1996).

3. Pregnancy and the subgingival microflora

Pregnancy is accompanied by many changes in the composition of the subgingival microflora. Jensen *et al.* (1981) and Korman and Loesche (1980,1982) showed that *Prevotella intermedia* and *Prevotella melaninogenica*, use either estradiol or progesterone as a substitute for naphthaquinone (Jensen *et al.* 1981) and vitamin K (Korman & Loesche 1982), as essential growth factors which encourage a proliferation of these microorganisms in subgingival plaque during pregnancy.

The correlation between the concentration of hormones in saliva and changes in oral microflora during pregnancy are summarized in Table 1. These data provide further support for the fact that hormonal changes during pregnancy promote microbiological changes in the subgingival flora. Most of these studies found a positive correlation between an increase in estradiol and progesterone and an overgrowth of *P.intermedia* (Korman & Loesche 1980, Muramatsu & Takaesu 1994, Gursoy *et al.* 2008, Carrillo-de-Albornoz *et al.* 2010). A positive correlation was also observed between an overgrowth of *Porphyromonas gingivalis*, *Tannerella forshytia* (Andriens *et al.* 2009) and *Campylobacter rectus* and an increase in estradiol concentrations. (Yokoyama *et al.* 2008).

It has been suggested that microbial changes observed during pregnancy may also occur at other sites in the body. High microbial counts in the vagina have been correlated with gingivitis in pregnant women when compared with patients without gingival inflammation (Person *et al.* 2009). Correlations between microbiological changes and increased gingival inflammation have also been extensively studied. The subgingival microflora increased from week 12 of pregnancy, was maintained during the second quarter and reduced during the third trimester to postpartum (Korman & Loesche 1980, Muramatsu & Takaesu 1994,

Yokoyama *et al.* 2008, Andriens *et al.* 2009). However, some studies had shown that these changes can be maintained throughout pregnancy (Gürsoy *et al.* 2009, Carrillo-de-Albornoz *et al.* 2010). Most of the studies agree that the increase in gingival inflammation occurs in the second quarter and is associated with an overgrowth of *P. intermedia*, (Korman & Loesche 1980, Muramatsu & Takaesu 1994). A correlation was also observed between an increase in gingival bleeding and an increase in *P. gingivalis* and *T. forsythia* (Andriens *et al.* 2009). After delivery, the levels of bacteria are reduced although, these changes can be sustained between 4 to 6 weeks postpartum (Gursoy *et al.* 2008, Andriens *et al.* 2009). The evidence supports the fact that clinical changes during pregnancy are associated with changes in the subgingival flora. However, other factors such as an impairment of cellular function and immunological changes may also contribute to the increased severity of gingivitis in pregnancy. (Figure 1, Figure 2).

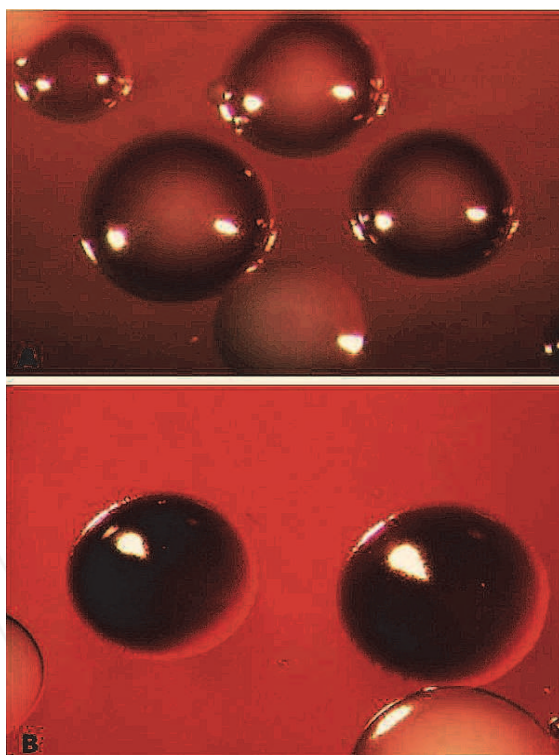


Fig. 1. A. *Prevotella intermedia* isolated from a pregnant patient. (Oral Basic Research Unit-UIBO, 2010 used for research purposes)



Fig. 2. Severe gingival changes in a woman with heavy plaque deposits during the second trimester (School of Dentistry, Universidad El Bosque, 2010. Used for academic resources)

Authors	Population	Design of Study	Hormone	Clinical changes	Time	Microorganisms
Korman & Loesche 1980	USA	Cross Sectional	Estradiol progesterone	Gingivitis	Second quarter	<i>P. intermedia</i> <i>P.melanogenica</i>
Muramatsu & Takaesu 1994	Japan	Cross Sectional	Estradiol progesterone	Bleeding	3 -5 month	<i>P. intermedia</i>
Yokoyama <i>et al</i> 2008	Japan	Cross sectional	Estradiol	Gingivitis	Second quarter	<i>C. rectus</i>
Gursoy <i>et al.</i> 2008	Finland	Cohort	No report	Gingivitis	12 weeks to end of pregnancy	<i>P. intermedia</i>
Andriens <i>et al.</i> 2009	Switzerland	Cohort	Estradiol progesterone	Gingivitis	12 - 28 weeks	<i>P. gingivalis</i> <i>T. forsythensis</i>
Carrillo de Albornoz <i>et al</i> 2010	Spain	Cohort	No report	Gingivitis	12 weeks to the end of pregnancy	<i>P. gingivalis</i> <i>P. intermedia</i>

Table 1. Clinical and Microbiological changes in subgingival plaque associated with hormonal changes during pregnancy.

4. Immunological changes during pregnancy

Increases in progesterone and prostaglandins modulate the immune system during pregnancy. Some degree of immunosuppression occurs during pregnancy which minimizes the risk of fetal rejection (Hansen 1988). Maternal tolerance of the fetal allograft could be the result of the integration of numerous mechanisms promoted by different cells presented in the decidua. Decidual macrophages and dendritic cells, which are found in close association with T lymphocytes are the most potent activators of T-lymphocyte responses and could play a sentinel function for the immune system, initiating antigen-specific T cell responses to fetal antigens (Piccini 2005). Progesterone and glucocorticoids share important anti-inflammatory and immunosuppressive properties and both hormones have potent anti-proliferative effects in mitogen activation and cytotoxic T cell generation (Stites *et al.* 1983). There is a decrease in CD4/CD8 ratio and peripheral blood lymphocytes and a low expression of HLA class I during pregnancy (Szekeres-Bartho *et al.* 1985). T cell cytokine profile could be modulated by the hormones present in the microenvironment; high doses of progesterone present at the feto-maternal interface and in the cumulus induce the production of IL-4, a strong inducer of Th2 profile which is anti-inflammatory. Progesterone also upregulates HLA Class I type G gene expression, which is the NK inhibitory ligand (Yie *et al.* 2006), suppresses the proliferation of CD4+ lymphocytes (Bainbridge *et al.* 2000) and induces apoptosis in activated CD8+ Lymphocytes (Fournel *et al.* 2000). Progesterone also down-regulates IL-6 production, rendering the gingiva less efficient at resisting the inflammatory challenges produced by bacteria (Lapp *et al.* 2003). Estradiol and progesterone levels increase in saliva during pregnancy, reaching a peak in the third trimester. Levels of IL-1 beta and PGE2 showed no significant change in their concentration in crevicular fluid during pregnancy. Although their concentrations were higher than non-pregnancy women, they did not correlate with clinical changes in gingival tissue (Figuero *et al.* 2010). However, there was an increased concentration of IL1-beta, IL6 and PGE2 in plasma in pregnant women with periodontitis, indicating that the presence of the disease can lead to increased systemic inflammatory markers (Offenbacher *et al.* 1998, Ebersole *et al.* 2010). A decrease in neutrophil chemotaxis has been observed during pregnancy, which may be due to the effects of sex hormones (Miyagi *et al.* 1992). These changes in the immune system may explain the susceptibility to infection during pregnancy and can support the clinical observation of complications in pregnant women with periodontitis.

5. Gingival changes during pregnancy and their treatment

The prevalence of gingivitis during pregnancy has been studied in different populations. (Ainamo *et al.* 1982). Studies that have assessed the prevalence of gingivitis during pregnancy using the CPITN index are shown in Table 2. The prevalence varies between 67 to 100%. In some studies, the prevalence and severity is higher in pregnant women when compared with non-pregnant women (Nuahma & Annan 1998, Rakchanok 2010). However, Miyazaki *et al.* 1991 observed no difference between pregnant and non-pregnant. Studies using the CPITN index reported that most pregnant women have calculus and gingival inflammation and few women have healthy gingiva during pregnancy. Most pregnant women have non-surgical treatment needs and oral hygiene instruction but very few require complex periodontal treatment (Table 2). Cohort studies support the evidence that pregnancy is associated with gingival changes, (Tilakaratne *et al.* 2000, Gürsoy *et al.* 2008, Carrillo-de-Albornoz *et al.* 2010). The clinical indicators evaluated in these studies were bleeding on probing and pocket depth without loss attachment, which indicated that this

may be due to a more pronounced gingival overgrowth in the proximal surfaces of anterior teeth (see figure 2). Few studies have determined the correlation of detectable levels of plaque and gingival clinical changes. However, two studies reported the same level of dental plaque in pregnant and controls; however, pregnant women responded more severely to dental plaque than non pregnant women (Gürsoy *et al.* 2008, Carrillo-de-Albornoz *et al.* 2010).

The period between weeks 12 and 28 of pregnancy can be characterized by increased susceptibility to plaque bacteria and an inflammatory response in the gingiva (Adraiens *et al.* 2009). Studies have not observed loss of attachment during pregnancy, but any pre-existing periodontitis is exacerbated. (Amar & Chung 1995). Progesterone can reduce local production of matrix metalloproteinases and may explain why pregnancy gingivitis may not necessarily progress to periodontitis (Laap *et al.* 1995, Gürsoy *et al.* 2010). Several cohort studies had shown that the loss of attachment can be observed during pregnancy and the predictor variables are depth of the pockets > 4 mm before week 26 weeks and presence of bleeding on probing (Moss *et al.* 2005). Thus, the loss attachment during pregnancy was not associated with pre-existing gingivitis, but with the presence of periodontal pockets when women became pregnant. During pregnancy, a significant change in tooth mobility can be also being observed. The initial mobility is dependent on the degree of vascularization and vascular volume of the periodontal ligament. When the female sex hormones act at high concentrations for prolonged periods, an increase in the permeability within the periodontal vascular system could occur. The resulting edema in the periodontal ligament may result in an increase in horizontal tooth mobility in the absence of any loss of periodontal support (Mealey & Moritz 2003).

Authors	Population	Sample size pregnant	Sample size control	Index	Prevalence % Pregnant/control	CIPTN % Periodontal Treatment Need					
						0	1	2	3		
Miyazaki <i>et al.</i> 1991	Japan	2424	1565	CPITN	95/96	5	5	70	20		
							Pregnant				
						4	4	75	20		
							No Pregnant				
Vasiliauskiene I.2003	Lintuania	1070	No control	CPITN	93	14	15,1	58	19.2		
Agbelusi <i>et al.</i> 2000	Laghos	250	No control	CPITN	67.8	32.2	13.6	50	18.9		
Wandera <i>et al.</i> 2009	Uganda	713	No Control	CPITN	67.3	32.7	3.3	63.4	0.6		
							CIPTN Mean Periodontal Status				
							0	1	2	3	4
Acharya & Bhat 2009	USA	259	204	CPITN	100%	0.66	1.91	2.66	0.70	0.10	
							Pregnant				
						2.41	1.71	0.99	0.29	0.09	
							No Pregnant				
Miyazaki H <i>et al.</i> 1991	Japan	2424	1565	CPITN	95/96	2.4	0.8	2.4	0.4	00	
							Pregnant				
						1.9	0.6	3.2	0.3	00	
							No Pregnant				

Table 2. Prevalence, Periodontal status and periodontal treatment needed in pregnant women.

Another clinical feature that may arise during the latter stages of pregnancy is the so-called pyogenic granuloma, (pregnancy tumor or epulis). This occurs in 1 to 5% of pregnant women (Amar & Chung 1995). These result from angiogenesis, caused by the increased levels of progesterone and the stimulatory effects of estradiol on the connective matrix. They usually arise in sites with pre-existing gingivitis (Jafarzadeh *et al.* 2006), and often involve the interdental papilla of one of the maxillary anterior teeth and rarely exceed 2 cm in diameter. When they persist they can be surgically removed and their removal should be delayed until after delivery. (Jafarzadeh *et al.* 2006, Rader *et al.* 2008). Their removal during pregnancy may be justified if they are continuously traumatized. Ideally they should be removed using CO₂ or Nd:YAG laser. (Powell *et al.* 1994, Lindenmüller *et al.* 2010). Surgery should only be done when the plaque and gingival inflammation have been controlled.

6. Knowledge, attitudes and practices of pregnant women

Poor prenatal care during pregnancy is often associated with women from deprived backgrounds. Such women have practices, attitudes and knowledge based on beliefs, myths and cultural tradition. These false beliefs that pregnancy per se has an adverse effect on the teeth and periodontal tissues lead to a lack of self care and deterioration of the oral health of these women. Evidence suggests that poor oral health can lead to obstetric problems such as low birth weight and preterm delivery (D'Angelo *et al.* 2007, Luce *et al.* 2011). A number of factors influence visits to the dentist during pregnancy such as social, personal and financial factors and lack of knowledge of the possible connection between oral health and pregnancy outcome (Machuca *et al.* 1999, Gaffield *et al.* 2001, Yalcin *et al.* 2002, Sarlati *et al.* 2004, Acharya & Bhat 2009). However, an assessment of pregnant women with a relatively high socioeconomic status in the U.S. found that 49% of respondents reported having attended a dentist, and 43% were aware of the connection between oral health and pregnancy outcomes. (Huebner *et al.* 2009). This suggests that better education focused on the importance of dental care before and during pregnancy should be provided to prevent future complications. (Al Habashneh *et al.* 2005).

We assessed the level of knowledge and oral health practices in pregnant women in a low socioeconomic population in Bogota, Colombia. The study showed that most pregnant women had good knowledge of the major oral diseases and how to prevent them; however, knowledge about the associations between pregnancy and perinatal complications were limited. Over 60% had attended the dentist during pregnancy and more than 50% claimed that they had received advice from their doctors and had been recommended to visit their dentist. However, they were not informed about the potential effect of changes in the mouth during pregnancy and the risk for pregnancy complications. In general, these women were from lower socioeconomic communities and the majority of women claimed to brush their teeth frequently and 35% used dental floss. These women had not perceived significant changes, such as gingival bleeding and swelling, during pregnancy. Women being treated at the community clinic, expressed fears of having radiographs, extractions and local anaesthesia during pregnancy. This study observed a significant improvement in the perception of oral health in a population that regularly attended public services and showed the impact of oral health care guide implemented in these public hospitals and emphasizes the importance of pre-conceptional preventive practices that improve the oral health of

women before they enter the pregnancy to minimize gingival and periodontal changes associated with this condition.(Lafaurie *et al.* 2011, unpublished data)

Another factor that influences health care during pregnancy is the low awareness amongst health care professionals of the changes that can occur in the oral cavity during pregnancy. There is clearly a need to provide health personnel with information on the importance of oral care during pregnancy (Al-Habashneh *et al.* 2008, Huebner *et al.* 2009, Salama *et al.* 2010).

7. Treatment of gingivitis during pregnancy

Few studies have assessed the effect of treatment on gingivitis during pregnancy. Most studies have evaluated the safety and effect of periodontal treatment on pregnant women with periodontitis. However, Lopez *et al.* (2005) assessed the safety and effect of treatment of gingivitis during pregnancy and found an increased risk of complications such as pre-term birth (PPT) and low birth weight (LBW) in women who were not treated.

The American Heart Association (AHA) guidelines for prevention of infective endocarditis report that bacteremia associated with oral bacteria was often associated with the patient's routine activities, such as chewing, tooth brushing and after therapeutic procedures (Wilson *et al.* 2008). Several studies have evaluated the presence of bacteremia in patients by mechanical stimuli such as brushing and flossing (Lockhart *et al.* 2008, Castra *et al.* 2009), chewing (Geerts *et al.* 2002, Ide *et al.* 2004) and ultrasonic scaling (Forner *et al.* 2006, Kinane *et al.* 2005). The studies showed that pregnant women with high levels of gingival inflammation can be exposed to bacteremia arising from the mouth.

Once oral bacteria gain access to blood vessels they can cross the placental barrier. Subgingival bacteria increase in pregnancy gingivitis, as it had been reported that *Streptococcus* ssp. and *Fusobacterium nucleatum* have been cultured from amniotic fluid in pregnant women (Bearfield *et al.* 2002). An increase of IgM antibodies to *F. nucleatum*, *P. intermedia* and *C. rectus* in fetal cord blood, were significantly higher for preterm as compared to full-term neonates. It has been suggested that fetal infections by these microorganism may be related to prematurity (Madianos *et al.* 2001). Fardini *et al.* (2010) injected bacteria obtained from human saliva and dental plaque into pregnant rats. They demonstrated that a wide range of oral microorganisms may be associated with intrauterine infection.

Given the evidence that periodontal status is associated with complications of pregnancy, some countries have started the implementation of technical standards and guidelines of care which includes oral care during pregnancy. The guideline developed by the State of California has been widely used in clinical practice and has been adapted by other states in the USA (Kumar J, Samuelson 2009). Such guidelines emphasize the need for the care of pregnant women and include the time the treatments to be performed, medications given during pregnancy and indications and contraindications for certain procedures.

The recommendations for periodontal treatment are as follows:

7.1 Dental treatment should be as frequent as possible during the second trimester (weeks 12 to 28) of pregnancy. However, some studies emphasize that gingival inflammation should be reduced early in pregnancy. Treatment, such as scaling and root planing can be performed from week 8 without increased risk for pregnancy (Lopez *et al.* 2002, 2005).

7.2 Diagnostic X-rays during pregnancy are safe and can improve the assessment of periodontal status. A panel of experts from the Food and Drug Administration (FDA)

concluded that the recommendations regarding the use of oral radiographs should not be altered because a patient is pregnant (American Dental Association, 2010). The number and type of radiographs depends on the clinical condition and the patient's medical history. As a standard practice for taking radiographs the patient should be protected with a vest that covers the neck and abdomen.

7.3 Most periodontal therapy can be performed with local anesthesia and it is important to note that this does not increase adverse fetal outcomes. Most of the anesthetics used in dentistry are classified as Class B by the FDA. However, mepivacaine and bupivacaine are classified as class C and are contraindicated in pregnancy. Local anesthetics cross the placental barrier by passive diffusion but are not teratogenic (Hool 2010). Although epinephrine is not teratogenic intravascular injection can be avoided by correctly aspirating with the syringe. (Martin & Varner 1994). Before the use of vasoconstrictors the blood pressure should be measured because of hypertension during pregnancy occurs between 6 and 10% of pregnancies.

Although these treatment guidelines exist for pregnant women, there are no specific protocols for the treatment of gingival inflammation in pregnant women. All the evidence, including work from our group, indicates that periodontal treatment can induce a bacteremia in patients with severe periodontal disease (Lafaurie *et al.* 2007, Castillo *et al.* 2011). Although most pregnant women have gingivitis during pregnancy the degree of inflammation can vary from mild to severe. The needs for management protocols for pregnant women with have not yet been defined. There are no clear regulations on the use of antiplaque products during pregnancy. Toothpastes containing triclosan have been reported to reduce gingivitis during pregnancy (Kraivaphan *et al.* 2009). Chlorhexidine has been associated with a reduction in cellular proliferation in vitro (Marioti *et al.* 1999) and desquamation of the mucosa had been reported (Jones 1997). Mouthwashes, such as chlorhexidine, have been used only once a day as part of periodontal therapy in women with gingivitis during pregnancy (Lopez *et al.* 2002, 2005). Based on this evidence it seems beneficial to use mouthwashes and toothpastes containing anti-plaque agents in patients with high levels of gingival inflammation.

8. Gingival status, gestational diabetes and perinatal complications

A perinatal risk factor is any biological property, environmental or social, which when present is associated with increased probability of an adverse event, either in the fetus, the mother, or both. Early identification of risk factors may allow strategic planning of prenatal care. Prematurity is the leading cause of neonatal morbidity and mortality worldwide and the frequency varies between populations. The World Health Organization (WHO) in 2000 estimated the prevalence of LBW is approximately 15.5% (7% for most developed countries, 16.5% for those in developing counties. The prevalence determined for each of the regions established by the United Nations was: Africa 14.3% Asia 18.3%, 6.4% Europe, Latin America and the Caribbean 10%, 7.7% North America, and Oceania 10.5%. The risk of a premature infant dying is 180 times greater than that of a full term baby and those that survive have an increased risk of disability. The World Health Organization in 1976 defined low birth weight (LBW) as below 2,500 grams (5.5 pounds) regardless of gestational age and defines pre-term delivery (PPT) as before 37 weeks of gestation.

Many factors have been associated with LBW and PPT. They include socio-demographic factors, maternal age <18 and > 35 years, black race, low socioeconomic status and lack of

access to health services. All have shown to increase the risk for these perinatal complications (Elster 1984, Buescher & Mittal 2006, Rosenthal & Lobel 2011). Other associated factors include a history of PPT prior to 35 weeks gestational age, placental ischemia, premature rupture of membranes and cervical incompetence and complications during pregnancy, such as genito-urinary infections, multiple gestation, bleeding in the second half of pregnancy and polyhydramnios have been considered as predictors for LBW and PPT (McCormick 1985, Ferraz *et al.* 1990, Alexander & Korenbrot 1995, Kramer *et al.* 1987, Heaman *et al.* 2008). Aspects related to the lifestyle, the consumption of snuff, alcohol and psychoactive substances and nutritional and psychosocial factors also increase the risk of perinatal complications. (Kogan 1995, Farrell *et al.* 2006, Lederman 2011).

Periodontal status during pregnancy has also been associated with perinatal complications. Numerous cohort studies have been conducted to evaluate the risk association between periodontitis and pregnancy complications (Lopez *et al.* 2002, Moreu *et al.* 2004, Pitiphat *et al.* 2008, Saddki *et al.* 2008, Agueda *et al.* 2008). Three systematic reviews demonstrate an increased risk for PPT, LBW and low birth-weight with preterm birth and intrauterine growth restriction in individuals with periodontitis (Xiong *et al.* 2007, Khader & Ta'ani 2005, Vergnes & Sixou M 2007). The risk varies between populations but in most studies the presence of periodontitis shown to be an independent risk factor for these complications.

Several studies have identified microorganisms associated with periodontal infections such as *P. gingivalis*, *Actinobacillus actinomycetemcomitans*, *F. nucleatum*, *P. intermedia*, *T. forsythia* and *Treponema denticola* in samples of placenta of women with preterm labor and preeclampsia. (Barak *et al.* 2007, León *et al.* 2007). The proteolytic capacity of these microorganisms and their ability to activate systemic proinflammatory mechanisms, facilitate these perinatal complications. Two periodontal organisms have been specially associated with LBW; *C. rectus* and *P. gingivalis*. Rat fetuses exposed to infection with *C. rectus* showed a decreased size and weight compared to a control group (Yeo *et al.* 2007, Simor *et al.* 1986, O'Sullivan *et al.* 1988). Associations between periodontal disease and LBW and PPT were explained also by relating the physiological processes that lead to the time of delivery as periodontal infection lead to increased serum levels of PGE₂, TNF, IL 1 β , IL6, which trigger a series event such as cervical dilation, uterine contractions start and the activation of metalloproteinases that generate the breakdown of amniochorion. It seems likely, that periodontal disease could lead to preterm delivery (Damare *et al.* 1997, Offenbacher *et al.* 1998, Dörtbudak *et al.* 2005, Ebersole *et al.* 2010).

Although a risk association between periodontitis and pregnancy complications is accepted, intervention studies comparing individuals treated with scaling and root planing with a control non treated group have proved to be conflicting. Three trials reported that treatment reduced the complications of pregnancy, (Lopez *et al.* 2002; Tarannum & Faizuddin 2007; Offenbacher *et al.* 2006). 4 studies in developed countries, however, failed to find an effect on pregnancy complications (Jeffcoat *et al.* 2005, Michalowicz *et al.* 2006, Newnham *et al.* 2009 Offenbacher *et al.* 2009). However, the studies differed in many respects: The type of population, sample size, presence of other perinatal risks, treatment received and by whom, and the weeks of gestation when the treatment took place. A systematic review (Polyzos *et al.* 2008) which evaluated 7 intervention studies found that scaling and root planing showed a protective effect for PPT OR 0.55 (0.35 to 0.87) but not for LBW OR 0.48 (0.23 to 1). The effect of treatment was significantly higher in patients without a history of PPT or LBW OR

0.48 (0.29 to 0.77) and a mild disease OR 0.49 (0.28 to 0.87). In 2010, the authors included another 3 studies in highly developed countries and show a loss of the protective effect of the periodontal treatment on perinatal complications (Polyzos *et al.* 2010).

Although the evidence is controversial, the periodontal treatment is a safe procedure and should be performed early in pregnancy between weeks 8 to 28. However it is important to further evaluate the treatment of advanced periodontal disease in patients with high perinatal risk. The most evidence-based studies show that periodontal treatment during pregnancy reduces further loss of attachment and improves the clinical status of the periodontium during pregnancy.

9. Periodontal status in high-risk women

Three conditions must be reviewed in relation to periodontal status and treatment needs during pregnancy.

9.1 Previous history of preterm delivery (PPT) and low birth weight (BWT)

The history of PPT and BWT is the most important risk factor for perinatal complications. The evidence indicates that periodontal treatment fails to reduce the incidence of pregnancy complications in patients with a history of PPT and LBW, It, It is necessary to review the protocols for periodontal management in patients with high levels of gingival inflammation. The use of antibiotics in chronic infections during pregnancy has been studied. The evidence indicates that antibiotics are safe during pregnancy and reduce perinatal complications (McDonald *et al.* 2007). Since gingival inflammation is associated with a polymicrobial flora, broad-spectrum antibiotics may be preferable in the treatment of pregnant women at perinatal risk. Beta-lactam antibiotics such as penicillin and cephalosporins are the drugs of choice. They are categorized as class B drugs by the FDA, cross the placenta, but are considered safe for the fetus (Nahum *et al.* 2006) If the patient is allergic to penicillin a macrolide antibiotic such as erythromycin, clindamycin and azithromycin, which are rated B by the FDA may be prescribed (Crider *et al.* 2009). However, antibiotics are only indicated in high-risk perinatal patients with high levels of inflammation and requiring extensive scaling and root planing. The use of antibiotics in these patients is warranted to control the high degree of bacteremia during mechanical treatment. The American Gynecology and Obstetrics Association suggest the following scheme for the prevention of infective endocarditis in pregnant women:

- Ampicillin 2 g intravenously 1 hour or 30 minutes before the procedure
- Cefazolin 1 g IV 1 hour or 30 minutes before the procedure
- Amoxicillin 2 g orally 1 hour or 30 minutes before the procedure
- Clindamycin 600mg 1 hour 30 min or earlier in patients who are allergic to penicillin

9.2 Hypertensive disorders of pregnancy

The prevalence of hypertension during pregnancy is between 6 and 10%. Hypertensive diseases and preeclampsia in particular are a cause of morbidity and perinatal and maternal mortality. They are more common in developing countries. The effect of periodontal infection on the incidence of preeclampsia has been evaluated in cohort studies. A systematic review showed an OR 1.76, 95% CI: 1.43-2.18, in women with preeclampsia compared with pregnant women without preeclampsia; the presence of periodontitis

increased the risk of perinatal complication (Vergnes *et al.* 2008). Because of the association between periodontitis and preeclampsia it is important that the periodontal status of pregnant women with preeclampsia risk are assessed in early pregnancy and treated before 20 weeks before presenting the early signs of this condition.

9.3 Gestational Diabetes

Gestational Diabetes Mellitus (GDM) is a carbohydrate intolerance of variable severity first recognized during pregnancy. Prevalence of GDM has been reported between 8 al 16%. (Moses *et al.* 2001, Chodick *et al.* 2011). Women with diabetes and with a past history of gestational diabetes, age > 40 and a body mass index > 35 Kg/m (BMI) are the most important factors for GDM during pregnancy (Teh *et al.* 2011). Women with gestational diabetes had a higher mean plaque index and higher mean gingival index than healthy pregnant women (Mittas *et al.* 2006). Patients with GDM and pregestational obesity had significantly more gingivitis and periodontal attachment loss than those with normal pregestational BMI. (Guthmiller *et al.* 2001, Chapper *et al.* 2005). Periodontal treatment should be considered when establishing future recommendations for metabolic control for this group of patients. However, in many cases, the periodontal treatment may be required by patients without good metabolic control with high levels of glycated hemoglobin (HbA1c) ≥ 8.0). In these uncontrolled diabetic patients with active periodontal disease, the first phase of treatment is to reduce levels of inflammation and prevent hyperglycemia produced by pain and stress of infection. The patient should be referred to a physician for a review of their metabolic control (Vermillo 2003.). Well controlled patients may be treated with conventional periodontal treatment. The use of antibiotics for periodontal treatment should be considered in these patients after consultation with their physician. Clinical protocols for gestational Diabetes Mellitus should be developed.

10. Conclusion and recommendations

Gingivitis during pregnancy is exacerbated by the hormonal changes that affect the host's responses to dental plaque. Ideally oral health policies and guidelines should be developed for the oral care of women before becoming pregnant. The treatment of gingivitis should commence at an early stage of the pregnancy to minimize the risk of more severe disease at a later stage. However, in high risk patient's treatment of periodontal disease should be undertaken with caution and the use of antibiotics may be recommended. Periodontal treatment improves the oral conditions of pregnant women and could help reduce perinatal complications.

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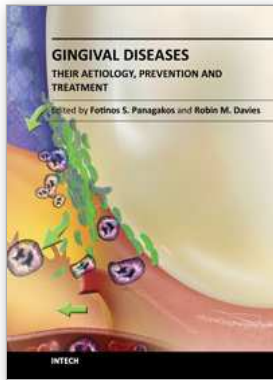
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Gingival diseases are a family of distinct pathological entities that involve the gingival tissues. These signs and symptoms of these diseases are so prevalent in populations around the world that they are often considered to be "normal" features. The diseases are now classified into two main groups namely: Plaque-Induced and Non-Plaque Induced Gingival Diseases. This book provides dentists, dental hygienists, dental therapists and students with a comprehensive review of gingival diseases, their aetiology and treatment.

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