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Original Article

Dentistry Section

Effects of Scaling and Root Planing on Gingival Status during Menstrual Cycle- A Cross-Sectional Analytical Study

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ABSTRACT

Introduction: Variations in sex steroid hormones, noticeable through the menstrual cycle of women, may impact periodontal health. A relationship between female sex hormone levels and periodontal changes during puberty, pregnancy, and menopause has been reported. Little research on gingival status at different periods of menstrual cycle, but very less work has been done to observe the effect of scaling on gingival status during different periods of menstrual cycle.

Materials and Methods: Thirty female subjects, aged 18-25 years were selected for a three month study. In Stage 1, clinical parameters {Plaque Index (PI), Gingival Index (GI), Modified Sulcular Bleeding Index (mSBI) and Probing depth (PD)} were recorded at three different time intervals {OV (Ovulation), PM (Premenstruation), M (Menstruation)} of their menstrual cycle, without scaling and polishing. In Stage 2, all clinical parameters were recorded at their subsequent menstrual cycle after scaling and polishing.

Results: In interstage analysis, OV 1 > OV 2, PM 1 > PM 2 and M 1> M 2. In intrastage analysis, for PI, mean difference between all values was not statistically significant. For mSBI, PM 1 > OV 1 > M 1, also PM 2 > OV 2 > M 2. For GI, PM 1 > OV 1 > M 1, also PM 2 > OV 2 > M 2. For PD, mean difference was not statistically significant.

Conclusion: Ovarian hormones influence gingival status of females, with an increase observed primarily during PM and OV phases of menstrual cycle. Scaling leads to a subsequent decrease in gingival inflammation.

Keywords: Gynaecology, Gingivitis, Sex hormones, Women's health

INTRODUCTION

Growth, development and reproduction are regulated and modulated by hormones; along with energy production, utilization and storage [1]. They also affect the development and integrity of the skeleton and oral cavity including periodontal tissues. An imbalance of these steroid hormones causes periodontal manifestations [2]. Though the bacterial plaque has been established as the primary aetiologic factor for the initiation of periodontal disease, however it has also been shown that though the periodontal pathogens are necessary but not sufficient for disease to occur, without a susceptible host [3]. The changes in the circulating levels of female sex hormones also affect the host response against dental plaque. Sexual hormones have been suggested as important modifying factors that may influence the pathogenesis of periodontal diseases [3].

According to the 1999 AAP Classification [4], female sex steroid hormones influence the periodontium. The classification includes gingival diseases modified by systemic factors; those associated with the endocrine system are classified as puberty, menstrual cycle, or pregnancy-associated gingivitis; under the broad category of dental plaque-induced gingival diseases [5].

Receptors for androgens, estrogen and progesterone are present in the gingival tissues and these hormones have effects on the oral mucosa and the periodontium [6-8]. Changes in the levels of Estrogen and progesterone seem to modify the gingival tissues, leading to a higher vascular permeability and decreased keratinization of the gingival epithelium [9,10]. Puberty is a complex process of sexual maturation, related to increased levels of the steroid sex hormones, testosterone in males and estradiol in females [11]. Several studies have demonstrated an increase in gingival inflammation without an accompanying increase in plaque levels along with rise in female sex steroid levels during the circumpubertal period [5].

The menstrual cycle is divided into two phases: a proliferative and a secretory phase and is a 25-30 day period. Proliferative phase is characterized by a gradual increase in production of gonadotropin (FSH) and of estrogens and, to a lesser degree, progesterone. There is a sudden and marked increase in production of gonadotropin and estrogens during ovulation. Studies have shown increase in the gingival exudation in all females on the day of ovulation, while the secretory phase is characterized by a gradual decrease in gingival exudation. It is observed that increase in sex hormones during the menstrual cycle modulate the development of localized gingival inflammation [11]. Women with gingivitis experience increased inflammation with an associated increase in crevicular fluid exudate during menstruation [12]. Most patients are not aware of any changes in their gingivae during their menstrual cycle, while a few experience enlarged haemorrhagic gingivae in the days preceding menstrual flow [13].

Periodontal health may be affected by fluctuations in sex hormones, which are also noticeable through the menstrual cycle of women. Common complaints among women undergoing dental and periodontal treatment are an increase in gingival inflammation and discomfort associated with their menstrual cycle, most commonly around the menses period [14].

Though, some research has been done to observe the gingival status at different periods of menstrual cycle due to changes in levels of different female sex hormones, but little work has been done to observe the effect of scaling and polishing on the gingival status during different periods of menstrual cycle. Hence, an attempt has been made to study the effect of scaling and root planing on the gingival status of females at three different time intervals {ovulation period (OV), pre-menstruation (PM) and menstruation (M)} during the menstrual cycle.

MATERIALS AND METHODS

Thirty female subjects, aged between 18-25 years were selected for a three month study from amongst the female students of Swami Devi Dyal Hospital and Dental College, Barwala, Panchkula, India.

Inclusion criteria

1. Females between age group of 18 to 25 years.
2. Normal and steady menstrual cycle, 26 to 30 days long.
3. Available for clinical examination in the upcoming 3-4 months.

Exclusion criteria

1. Metabolic or systemic condition that might affect the periodontium.
2. Use of oral contraceptives or any other drugs that might affect the levels of sex hormones.
3. Use of antibiotic or anti-inflammatory or immunosuppressive drugs during a 3-month period prior to the start of the study.
4. Use of tobacco products.
5. Periodontal therapy during the last 6 months.
6. Having destructive periodontal disease (Clinical Attachment Loss >3 mm).
7. Pregnancy or intention to become pregnant during the study period.

The study was divided into two stages: Stage 1: Before scaling and polishing; Stage 2: After scaling and polishing. Informed consent was taken from all the subjects and ethical clearance was obtained from the institutional ethical committee board.

In both the stages, clinical parameters were recorded at three different time intervals {ovulation (OV), premenstruation (PM), menstruation (M)} of their menstrual cycle as per the preliminary time table determined for each subject [Table/Fig-1].

Periods of recording	Range of Menstrual cycle (days)	
	26 to 28 days	28 to 30 days
Ovulation	14th day	15th day
Premenstruation	22nd day	24th day
Menstruation	1st day	1st day

[Table/Fig-1]: Preliminary time table depicting the range of menstrual cycle

In Stage 1, the clinical parameters of all 30 female subjects were recorded at the three different time intervals of their menstrual cycle without doing scaling and polishing (oral prophylaxis).

In Stage 2, all the subjects were recalled 7 days after the beginning of their previous menstruation and a thorough scaling and polishing was done and the subjects were instructed in comprehensive plaque control regime. They were instructed to brush twice daily and use 0.2% chlorhexidine mouthwash after brushing. The clinical parameters were then recorded at 3 different time intervals of their subsequent menstrual cycle (i.e. around 35 days after scaling).

The following clinical parameters were recorded for each tooth.

1. **Plaque Index (PI) (Silness P, Loe H)** [15]: measured at four sites around each tooth.
2. **Gingival Index (GI) (Loe H, Silness J)** [16]: measured at four sites around each tooth.
3. **Modified sulcular bleeding Index (mSBI) (Mombelli et al.,)** [17]: measured at four sites around each tooth.
4. **Probing depth (PD):** measured at four sites around each tooth. The four sites include: mesiobuccal, distobuccal, mesiolingual and distolingual, measured with a UNC-15 probe using walking probe technique.

The clinical data was collected, compiled and put to statistical analysis.

RESULTS

The results were compiled and statistically analysed using paired T-test. The data was analysed in two parts: interstage (i.e., between stage 1 and stage 2) and intrastage (i.e., within stage 1 or stage 2) analysis.

INTER STAGE ANALYSIS [Table/Fig-2-4].

Plaque Index (PI) values [Table/Fig-2]:

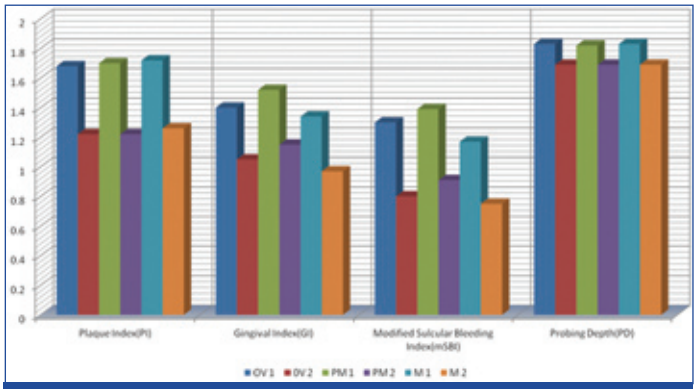
The mean difference between the values of OV1 and OV2 was found to be statistically highly significant (p=0.001), between PM1 and PM2 was found to be statistically highly significant (p=0.001), and between M1 and M2 was found to be statistically highly significant (p=0.001).

	Menstrual cycle (MC) interval	Mean	Standard deviation (SD)	p-value
Plaque Index (PI)	OV 1	1.68	0.230	0.001
	OV 2	1.22	0.304	
	PM 1	1.70	0.230	0.001
	PM 2	1.22	0.254	
	M 1	1.72	0.213	0.001
	M 2	1.26	0.264	
Gingival Index (GI)	OV 1	1.40	0.197	<.001**
	OV 2	1.05	0.204	
	PM 1	1.52	0.208	<.001**
	PM 2	1.15	0.197	
	M1	1.34	0.214	<.001**
	M 2	0.97	0.209	

[Table/Fig-2]: Interstage comparisons of Plaque Index (PI) and Gingival Index (GI)
**-highly significant (p value ≤ 0.01)

	Menstrual cycle (MC) interval	Mean	Standard deviation (SD)	p-value
Modified Sulcular Bleeding Index (mSBI)	OV 1	1.30	0.329	<.001**
	OV 2	0.80	0.297	
	PM 1	1.39	0.343	<.001**
	PM 2	0.91	0.305	
	M 1	1.17	0.339	<.001**
	M 2	0.75	0.302	
Probing Depth (PD)	OV 1	1.83	0.323	0.004**
	OV 2	1.69	0.314	
	PM 1	1.82	0.263	0.002**
	PM 2	1.69	0.306	
	M 1	1.83	0.316	0.002**
	M 2	1.69	0.311	

[Table/Fig-3]: Interstage comparisons of Modified Sulcular Bleeding Index (mSBI) and Probing Depth (PD)
**-highly significant (p value ≤ 0.01)



[Table/Fig-4]: Graph depicting Interstage comparisons of mean values of all the parameters (PI, GI, mSBI, PD)

Gingival Index (GI) values [Table/Fig-2]:

The mean difference between the values of OV1 and OV2 was found to be statistically highly significant (p <0.001), between PM1 and PM2 was found to be statistically highly significant (p <0.001), and between M1 and M2 was found to be statistically highly significant (p <0.001).

Modified Sulcular Bleeding Index (mSBI) values [Table/Fig-3]:

The mean difference between the values of OV1 and OV2 was found to be statistically highly significant (p <0.001), between PM1 and PM2 was found to be statistically highly significant (p <0.001), and between M1 and M2 was found to be statistically highly significant (p-value <0.001).

Probing depth (PD) values [Table/Fig-3]:

The mean difference between the values of OV1 and OV2 was found to be statistically highly significant (p=0.004), between PM1 and PM2 was found to be statistically highly significant (p=0.002), and between M1 and M2 was found to be statistically highly significant (p =0.002).

INTRA STAGE ANALYSIS [Table/Fig-5,6]

Plaque Index (PI) values [Table/Fig-5]:

The mean difference between the values of OV1 and PM1 was found to be statistically not significant (p=0.452), between OV1 and M1 was found to be statistically not significant (p = 0.181), and between PM1 and M1 was found to be statistically not significant (p=0.437). The mean difference between the values of OV2 and PM2 was found to be statistically not significant (p=0.926), between OV2 and M2 was found to be statistically not significant (p = 0.159), and between PM2 and M2 was found to be statistically not significant (p=0.085).

Gingival Index (GI) values [Table/Fig-5]:

The mean difference between the values of OV1 and PM1 was found to be statistically highly significant (p = <0.001), between OV1 and M1 was found to be statistically significant (p = 0.028), and between PM1 and M1 was found to be statistically highly significant (p <0.001). The mean difference between the values of OV2 and PM2 was found to be statistically significant (p = 0.019), between OV2 and M2 was found to be statistically significant (p = 0.016), and between PM2 and M2 was found to be statistically highly significant (p=0.001).

M**odified Sulcular Bleeding Index (mSBI) values** [Table/Fig-6]:

The mean difference between the values of OV1 and PM1 was found to be statistically highly significant (p= <0.004), between OV1 and M1 was found to be statistically highly significant (p <0.001), and between PM1 and M1 was found to be statistically highly significant (p <0.001). The mean difference between the values of OV2 and PM2 was found to be statistically highly significant (p=0.001), between OV2 and M2 was found to be statistically significant (p=0.043), and between PM2 and M2 was found to be statistically highly significant (p=0.001).

	Menstrual cycle (MC) interval	Mean	Standard deviation (SD)	p-value
Plaque Index (PI)	OV1	1.68	0.230	0.452
	PM1	1.70	0.230	
	OV1	1.68	0.230	0.181
	M1	1.72	0.213	
	PM1	1.70	0.230	0.437
	M1	1.72	0.213	
	OV2	1.22	0.304	0.926
	PM2	1.22	0.254	
	OV2	1.22	0.304	0.159
	M2	1.26	0.264	
	PM2	1.22	0.254	0.085
	M2	1.26	0.264	
Gingival Index (GI)	OV1	1.40	0.197	<.001**
	PM1	1.52	0.208	
	OV1	1.40	0.197	0.028*
	M1	1.34	0.214	
	PM1	1.52	0.208	<.001**
	M1	1.34	0.214	
	OV2	1.05	0.204	0.019*
	PM2	1.15	0.197	
	OV2	1.05	0.204	0.016*
	M2	0.97	0.209	
	PM2	1.15	0.197	0.001**
	M2	0.97	0.209	

[Table/Fig-5]: Intrastage comparisons of Plaque Index (PI) and Gingival Index (GI)
**- highly significant (p value ≤ 0.01), * - significant (p ≤ 0.05)

	Menstrual cycle (MC) interval	Mean	Standard deviation (SD)	p-value
Modified Sulcular Bleeding Index (mSBI)	OV1	1.30	0.329	0.004**
	PM1	1.39	0.343	
	OV1	1.30	0.329	<.001**
	M1	1.17	0.339	
	PM1	1.39	0.343	<.001**
	M1	1.17	0.339	
	OV2	0.80	0.297	0.001**
	PM2	0.91	0.305	
	OV2	0.80	0.297	0.043*
	M2	0.75	0.302	
	PM2	0.91	0.305	0.001**
	M2	0.75	0.302	
Probing Depth (PD)	OV1	1.83	0.323	0.795
	PM1	1.82	0.263	
	OV1	1.83	0.323	0.817
	M1	1.83	0.316	
	PM1	1.82	0.263	0.938
	M1	1.83	0.316	
	OV2	1.69	0.314	0.881
	PM2	1.69	0.306	
	OV2	1.69	0.314	0.987
	M2	1.69	0.311	
	PM2	1.69	0.306	0.835
	M2	1.69	0.311	

[Table/Fig-6]: Intrastage comparisons of Modified Sulcular Bleeding Index (mSBI) and Probing Depth (PD)
**- highly significant (p value ≤ 0.01), * - significant (p ≤ 0.05)

Probing depth (PD) values [Table/Fig-6]:

The mean difference between the values of OV1 and PM1 was found to be statistically not significant (p=0.795), between OV1 and M1 was found to be statistically not significant (p=0.817), and between PM1 and M1 was found to be statistically not significant (p=0.938). The mean difference between the values of OV2 and PM2 was found to be statistically not significant (p=0.881), between OV2 and M2 was found to be statistically not significant (p = 0.987), and between PM2 and M2 was found to be statistically not significant (p=0.835).

DISCUSSION

Periodontal health of women may be affected by the fluctuations in sex hormones observed through the menstrual cycle [18]. Estrogen and progesterone changes seem to modify the gingival tissues, leading to a higher vascular permeability and decreased keratinization of the gingival epithelium. The changes in the circulating levels of female sex hormones also affect the host response against dental plaque [19]. A relationship between female sex hormone levels and periodontal changes during puberty, pregnancy, and menopause has been postulated [14,20].

During menstrual cycle increased levels of sex hormones may lead to localized gingival inflammation [7,14,21-23]. The effect of scaling on gingival status of 30 female subjects was studied in a three month long study; which was divided into two stages: Stage 1: Before Scaling and Stage 2: After Scaling. In the interstage analysis (OV 1– ovulation day of stage 1, PM 1– premenstruation day of stage 1,

M1– menstruation day of stage 1, OV 2-ovulation day of stage 2, PM 2– premenstruation day of stage 2 and M 2– menstruation day of stage 2) the mean differences between the values of OV 1 and OV 2, PM 1 and PM 2, M 1 and M 2 for all the parameters recorded (PI, GI, mSBI and PD) was statistically highly significant (p< 0.01). There was a steady decrease in the values of PI, GI, mSBI and PD recorded from stage 1 to stage 2.

In the intrastage analysis, for Plaque Index (PI), the mean difference between the values of OV 1 and PM 1 (p=0.452), OV 1 and M 1 (p=0.181), PM 1 and M 1 (p=0.437), OV 2 and PM 2 (p=0.926), OV 2 and M 2 (p=0.159), PM 2 and M 2 (p=0.085) were statistically not significant; suggesting little or no effect of hormonal variations during the menstrual cycle on the values of PI. These results confirmed with the study by Machtei et al., [14], in which results showed that mean PI was almost identical at all time points during the menstrual cycle. These results are also in confirmation with the results obtained by Baser et al., [24] in which the Plaque Index (PI) scores did not significantly change during the duration of menstrual cycle at different time points.

For Modified Sulcular Bleeding (mSBI) Index values, the values observed during PM 1, were >OV 1 and the results were found to be statistically highly significant (p<0.004). Also, the values of mSBI observed during OV 1, were >M 1 and the results were found to be statistically highly significant (p<0.001). The values of mSBI observed during PM1 were >M1 and the results were statistically highly significant; suggesting that during stage 1, the values of mSBI during PM 1 >OV 1 >M 1.

The values of mSBI during PM2 were >OV2 and results were statistically highly significant. Also, the values (mSBI) observed during OV2 were >M2 and the results were statistically significant (p=0.043). The values (mSBI) observed during PM2 >M2 and the results were statistically highly significant (p=0.001); suggesting that the values (mSBI) during PM2 >OV2 >M2. These results confirmed with the results obtained by Baser et al., [24], in which bleeding on probing (BOP) was significantly elevated at the progesterone day (PgD) compared to the menstruation day (MD) and ovulation day (OD). However, our results are not in confirmation with the study by Becerik et al., [19], in which BOP were significantly higher in ME and OV than in the PM phase in the gingivitis group.

For Gingival index values (GI), the values observed during PM1 were >OV1 and the results were statistically highly significant, also OV1 were >M1 and the results were statistically significant (p=0.028). GI observed during PM1 were >M1 and results were found to be statistically highly significant (p<0.001), suggesting that the values of GI during PM 1>OV1>M1.

GI observed during PM2 were > OV2 and results were statistically significant (p=0.019), also OV2 were > M2 and results were statistically significant (p=0.016). GI observed during PM2 were > M2 and the results were statistically highly significant (p=0.001), suggesting that GI during PM2 > OV2 > M2. These results were in confirmation with the study by Machtei et al., [14] in which the values of GI during OV and PM were > than in M.

For Probing Depth (PD), the mean difference between the values of OV1 and PM1 (p=0.795), OV1 and M1 (p=0.817), PM1 and M1(p=0.938), OV2 and PM2 (p=0.881), OV2 and M2 (p=0.987), PM2 and M2 (p=0.835) were statistically not significant, suggesting that little or no influence of hormonal variation during the menstrual cycle on the values of PD. Results were in confirmation with a study by Machtei et al., [14] in which the mean patient's probing depth was not significant at three different time intervals during their menstrual cycle.

Hence, it was observed that there was an increase in the inflammation of gingiva, which was highest during PM1 and PM2, followed by OV1 and OV2 and lowest during M1 and M2. These findings confirmed with a study by Machtei et al., [14], in which they compared the periodontal status of premenopausal women at three different times during their menstrual cycle and observed that, GI was significantly higher in OV and in PM than in M; also mean patient's probing depth and CAL was not significantly different between examinations.

In our study increases in GI and mSBI observed during the PM and OV, confirmed with a study by Shourie et al., [25], in which women with healthy gingiva showed negligible changes throughout menstrual cycle, increased inflammation was observed during OV and PM as compared to M. Our study shows that GI varies, with increase in values seen during PM compared to M, these results confirmed with results obtained by Baser et al., [24], whose results showed that BOP was significantly elevated at the progesterone day compared to the menstruation day and ovulation day (p <0.01); also PI scores did not significantly change throughout the study.

The increased scores of GI and mSBI, may be attributed to interaction between sex hormones and specific inflammatory cells in the periodontium. Fluctuation in hormonal levels is observed throughout the menstrual cycle, in which estradiol (E2) levels peak at OV and drop immediately after; a second peak is observed during PM. Levels of progesterone are low initially, with a steady increase from OV to a peak a few days before M, with a sharp decline thereafter. Hence, the increase in GI and mSBI at PM and OV may be primarily attributed to the increase in E2 levels: this peak in E2 during OV and the second peak just before M (associated with a surge in progesterone levels) are associated with increased gingival inflammation and bleeding. The common notion of higher gingival inflammation during M might in fact be confused with this PM increase. These observations were similar to a study by Elattar T and Hugoson A [26] who observed that aggravation of gingival inflammation was due to increased levels of female sex hormones.

In our study the values of GI and mSBI were increased during PM and OV and comparatively reduced during M, while these results did not confirm with the findings by a study by Becerik et al., [25], who observed that the bleeding on probing were significantly higher in ME and OV, than in the PM phase in gingivitis group.

Holm-Pedersen and Loe [12], observed no correlation between the condition of gingiva and different phases of menstrual cycle in clinically healthy gingiva, whereas significant deterioration of pre-existing gingivitis was observed during the day of menstruation; which was contrary to our results.

CONCLUSION

Scaling has an influence on the gingival status of female patients with chronic gingivitis. It leads to a subsequent decrease in gingival inflammation after scaling and polishing. Scaling results in lowering the values of all the clinical parameters recorded (i.e., PI, GI, mSBI and PD). The ovarian hormones (i.e., estrogen and progesterone) influence the gingival status of females, with an increase in gingival inflammation due to an increase in their levels, observed primarily during PM and OV phases of the menstrual cycle. The changes in the ovarian hormonal levels cause an increase in the values of GI and mSBI during PM and OV phases of the menstrual cycle. The changes in the ovarian hormonal levels do not significantly affect the PI and the PD values in patients with chronic gingivitis. The ovarian hormones may play a role in exaggeration of pre-existing inflammation in the gingival tissues. However, further studies with greater sample sizes are necessary to clearly understand the relationship of the gingival status, the ovarian hormonal levels and the effects of periodontal treatment during the various phases of the menstrual cycle.

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