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Evaluation of gingival crevicular fluid volume in relation to clinical periodontal status with periotron 8000

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Abstract

Context: The presence of gingival crevicular fluid (GCF) in the gingival crevice is an indicator of inflammation. There are various methods of collecting GCF. One of these methods is the collection of GCF with absorbent paper strips.

Aims: The aim of the study was to evaluate the relationship between GCF volumes with different periodontal status at various tooth site locations.

Settings and Design: This was a randomized clinical trial. GCF was obtained from the gingival crevice in 32 tooth sites of 12 individual participants.

Methods and Material: Clinical parameters such as gingival index (GI) & probing depth (PD) were recorded. GCF was collected with absorbent paper strips from the gingival crevice of incisor, canine, premolar and molar. These strips were placed in periotron 8000 device (Oraflow Inc) to quantify GCF volume.

Statistical analysis used: One way ANOVA was carried out for comparison of mean GCF volume among subgroups of GI and PD at various tooth site location.

Results: GCF volumes collected at various anatomical sites were varying in amount. GCF volume increases with the increase in GI and PD.

Conclusions: This study concludes that there is variation in an increase in GCF volume collected from various tooth sites of different periodontal status.

Keywords: gingival crevicular fluid volume, inflammation, periotron

Introduction

The advances in the technology had led to enhancement in the field of Periodontology. Gingival crevicular fluid (GCF) was identified through limited numbers of studies in 1940. Origin and collection of GCF were widely studied between the periods of 1950-1970. Some longitudinal trails since 1990 had evaluated the diagnostic importance of GCF components. The development of easier and accurate method for GCF collection had boosted the research in periodontology.

Brill (1959) has confirmed the presence of GCF in humans and considered it as a transudate^[1]. Loe (1965) demonstrated that GCF is inflammatory exudates, not a continuous transudate^[2]. GCF is considered as an inflammatory exudates and its presence is due to inflammation was seen microscopically in the clinically healthy gingival sulcus^[3].

GCF could be collected by various methods. The various methods include twisted threads, micropipettes, crevicular washings and absorbent paper strips. The absorbent paper strips is a suitable method for GCF collection^[4].

In the present study, GCF was collected with absorbent paper strips and its volume was measured with an electronic device i.e Periotron 8000 (Oraflow Inc). The amount of GCF volume was correlated to gingival index, probing depth at various tooth sites location. This study was undertaken to determine the relative changes in gingival crevicular fluid volume with respect to different periodontal status at various tooth sites.

Method

Patients in the outpatient department of Periodontology with informed consent were included in the study. This study was designed as a randomized clinical trial. A total of 32 tooth sites with gingival crevice of more than 5mm were randomly selected in 12 patients. The age group

of 26-65 years with at least 20 natural teeth in the oral cavity was included. Exclusion criteria were patients with systemic disease, smoking or intake of any drug within last 6 months. The GCF was collected from incisor, canine, premolar and molar from the maxillary arch. The tooth selected was isolated and absorbent paper strip (Periopaper, Ora flow) held by forceps was placed in the gingival crevice for GCF collection [Figure 1 & Figure 2]. The strip was inserted 1mm into the gingival crevice and placed there for 30 sec^[5]. The paper strips were placed between two electrodes of an electronic device (Periotron 8000, Ora flow Inc) [Figure 3]. Periotron displayed a numerical score indicating the GCF collected [Figure 4]. Numerical score was converted to microliters with Oracare software. Electrodes of device were disinfected with aldehyde and then air dried. Insertion of paper strips caused bleeding at some tooth sites. The contaminated strips with blood or oral fluids were discarded. The clinical parameters were recorded after the placement of paper strip. Gingival index score (GI) and probing depth (PD) were measured [Figure 5]. The gingival index given by Loe and Sillness was grouped under the following^[6].



Fig 4: Periotron displaying score



Fig 5: Probing depth measured with periodontal probe



Fig 1: Periopaper strips



Fig 2: Periopaper strip inserted into gingival sulcus



Fig 3: Periopaper strips transferred to periotron

The scoring system per surface was as follows

| Score | Criteria |
|-------|---|
| 0 | Normal Gingiva |
| 1 | Mild inflammation, slight change in color, slight edema, no bleeding on palpation |
| 2 | Moderate inflammation, redness, edema, glazing; bleeding on probing |
| 3 | Severe inflammation, marked redness and edema, ulceration; tendency to spontaneous bleeding |

Results

The clinical parameters GI and PD recorded was tabulated and compared.

Gingival scores were grouped as

- G 0 - Gingival Index Score 0
- G 1- Gingival Index Score 1
- G 2- Gingival Index Score 2
- G 3- Gingival Index Score 3

For the purpose of statistical analysis, the probing depth was grouped as follows

- Group I - PD <3 mm
- Group II- PD 3-5 mm
- Group III- PD >5 mm

Statistical analysis

One way ANOVA (Analysis of variance test) was used to evaluate

- Mean GCF volume and subgroups of GI (Table 1)
- Mean GCF volume and subgroups of PD (Table 2)

One way ANOVA (Analysis of variance test) was used to evaluate

- Mean GCF volume and subgroups of GI at different tooth sites (Table 3)

- Mean GCF volume and subgroups of PD at different tooth sites (Table 4)

The mean GCF volume with respect to different tooth sites Incisor, the mean GCF volume was (0.12 -0.69 µl) Canine, the mean GCF volume was (0.17-0.79 µl) Premolar, the mean GCF volume was (0.12-0.89 µl) Molar, the mean GCF volume was (0.24-0.93 µl) There was a significant difference found between means of GCF volume (P<0.05) among different groups of gingival index scores (Table 1 & Table 3). The increase inflammation in gingival tissue affects GCF volume in the gingival crevice. There was a significant difference found between means of GCF volume (P<0.05) among different groups of probing depth (Table 2 & Table 4). The increase probing depth caused an increase in surface area of gingival crevice. This resulted in an increase in GCF volume. From incisor to molar, the surface area of the gingival crevice increases. Hence, there was an increase in GCF volume collected from incisor to molar area.

Table 1: Mean GCF volume and statistical differences among subgroups with different GI scores

| Gingival Index(GI) | n | µl GCF arithmetic Mean ± SD | ANOVA |
|--------------------|----|-----------------------------|--------------------|
| G0 | 10 | 0.22 ±0.004 | F 1749 P<0.0001 |
| G1 | 8 | 0.46 ±0.002 | |
| G2 | 8 | 0.63 ±0.024 | |
| G3 | 6 | 0.91 ±0.035 | |

There is significant difference among means (P<0.05)

Table 2: Mean GCF volume and statistical differences among subgroups with different PD

| Probing depth(PD) | n | µl GCF arithmetic Mean ± SD | ANOVA |
|-------------------|----|-----------------------------|---------------------|
| Group I (<3 mm) | 14 | 0.34 ± 0.008 | F 783.6 P<0.0001 |
| Group II (3-5 mm) | 10 | 0.68 ± 0.014 | |
| Group III (>5mm) | 8 | 0.96 ± 0.071 | |

There is significant difference among means (P<0.05)

Table 3: Mean GCF volume and statistical differences among subgroups based on GI Scores

| Sampling area | GI | n | µl GCF arithmetic Mean ± SD | ANOVA |
|---------------|----|---|-----------------------------|---------------------|
| Incisor | G0 | 2 | 0.12±0.001 | F 306.8 P<0.0001 |
| | G1 | 2 | 0.24±0.012 | |
| | G2 | 2 | 0.45±0.023 | |
| | G3 | 2 | 0.69±0.031 | |
| Canine | G0 | 2 | 0.17±0.003 | F 237 P<0.0001 |
| | G1 | 2 | 0.24±0.017 | |
| | G2 | 2 | 0.62±0.032 | |
| | G3 | 2 | 0.79±0.041 | |
| Premolar | G0 | 2 | 0.12±0.009 | F 783.6 P<0.0001 |
| | G1 | 2 | 0.45±0.018 | |
| | G2 | 2 | 0.63±0.034 | |
| | G3 | 2 | 0.89±0.045 | |
| Molar | G0 | 2 | 0.24±0.008 | F 115.8 P<0.0002 |
| | G1 | 2 | 0.54±0.012 | |
| | G2 | 2 | 0.71±0.034 | |
| | G3 | 2 | 0.93±0.067 | |

There is significance difference between means P<0.05

Table 4: Mean GCF volume and statistical differences among subgroups based on PD

| Sampling area | PD | n | µl GCF arithmetic Mean ± SD | ANOVA |
|---------------|-------------------|---|-----------------------------|---------------------|
| INCISOR | Group I (<3 mm) | 4 | 0.22±0.007 | F 617.1 P<0.0001 |
| | Group II (3-5 mm) | 3 | 0.43±0.012 | |
| | Group III (>5mm) | 3 | 0.79±0.037 | |
| CANINE | Group I (<3 mm) | 3 | 0.24±0.004 | F 532.4 P<0.0001 |
| | Group II (3-5 mm) | 2 | 0.51±0.016 | |
| | Group III (>5mm) | 2 | 0.79±0.033 | |
| PREMOLAR | Group I (<3 mm) | 3 | 0.12±0.004 | F 1750 P<0.0001 |
| | Group II (3-5 mm) | 3 | 0.64±0.016 | |
| | Group III (>5mm) | 2 | 0.86±0.023 | |
| MOLAR | Group I (<3 mm) | 3 | 0.32±0.013 | F 43.13 P<0.0020 |
| | Group II (3-5 mm) | 2 | 0.68±0.064 | |
| | Group III (>5mm) | 2 | 0.93±0.131 | |

There is significant difference among means (P<0.05)

Discussion

There are various methods by which GCF could be collected from the gingival crevice. In the present study, the absorbent paper was used to collect GCF and an electronic device (Periotron) was used to measure GCF collected from various tooth sites.

Periotron is an electronic device designed for the collection of gingival crevice fluid (GCF) and salivary flow. The models of periotron are Periotron 600 (1976), Periotron 6000 (1983) and Periotron 8000(1995) [7, 8]. The absorbent paper strips absorb about 0-1.2 µl of GCF. The absorbent paper strips of 1mm can effectively collect GCF from the gingival crevice. [9, 10]

The time of collection of GCF was set between 9 AM to 11 AM. The time of collection of GCF should remain constant in the study as there is a gradual increase in GCF from 6 AM to 10 PM [3]. Maxillary tooth sites were selected for GCF collection in the present study as better isolation was obtained. [11, 12] The GCF volume increases with any kind of

mechanical stimulation. Thus, periopaper strips were placed just 1mm into the gingival crevice to prevent any mechanical stimulation during insertion of paper strips.

GCF volume depends on the area of gingival crevicular space, variations in anatomy, the severity of inflammation, gravitational effect, the method of collection and sampling time. [13, 14] In the present study, the GCF sample was collected in the maxillary arch in order to eliminate the influence of the gravitational effect. The mean GCF volume collected in this study was (0.12-0.93 µl). The mean GCF volume collected with the previous studies conducted were Arzu *et al.* [15] (0.06 to 0.5 µl), Smith *et al.* [16] (0.01 to 0.5 µl) and Tsuchidak *et al.* [17] (0.01 to 0.6 µl).

Previous studies have shown the relationship between GCF measurements and clinical signs of gingival inflammation [18, 19]. In this study, the mean GCF volume increased with increase in GI scores. With the increase in the severity of gingival inflammation, the permeability of gingival

epithelium is increased. This leads to increase the flow of GCF in gingival crevice, thus resulting in a higher volume of GCF collected in sites with higher GI scores.

In the present study, the mean GCF volume increased with the increase in probing depth. With the increase in probing depth, the surface area of gingival crevice increases. Thus, resulting in a higher amount of GCF volume collected from greater probing depth. Similar to previous studies variation in GCF volume was found among the different tooth site locations^[20]. The GCF volume increased from incisor to molar due to the increase in surface area of the gingival crevice.

Periotron is a good chairside device to determine an increase in GCF volume. The problem encountered during GCF sample collection is the contamination with saliva and blood. In presence of a high gingival index, there is bleeding from gingival tissue which obscures the readings. Thus, it can be a diagnostic device to determine the initiation of periodontal disease. It can also be utilized to monitor individuals during their maintenance phase of therapy.

Conclusion

This study states that there is great fluctuation in GCF volume collected from various tooth sites. There is also variation in GCF volume collected from sites with different gingival index and probing depth. The electronic devices used for the studies on GCF can have an influence on the results and inference. The variation of GCF volume collected with respect to different periodontal status and tooth sites should be taken into consideration before designing further studies. Studies which validate their results on GCF volume should take this observation into consideration for future research purpose.

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Conflict of Interest: Nil

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