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Gingival crevicular fluid and peri-implant sulcus fluid

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ABSTRACT

Gingival crevicular fluid (GCF) is an important source for the assessment of periodontal and peri-implant disease activity and response to periodontal therapy. GCF contains cellular components such as epithelium, bacteria, leukocytes, erythrocytes, viruses and their by-products, electrolytes, bacterial metabolic products, host and bacterial enzymes, and enzyme inhibitors such as acid phosphatase, alkaline phosphatase, cytokines, and immunoglobulins. In addition, it is also found that drugs taken systemically pass into the GCF.

Keywords: Gingival crevicular fluid, peri-implant sulcus fluid

INTRODUCTION

Tissue color, contour, presence of bleeding on probing (BOP), gingival recession, pocket depth (PD), clinical attachment level (CAL), suppuration, and tooth mobility are considered in the diagnosis and evaluation of diseases affecting the periodontium.[1] Radiographs contribute to the diagnosis by showing bone loss around the teeth.[2] However, these techniques only determine past disease activity. Reliable diagnostic methods are required to evaluate disease activity and response to periodontal treatment.[3]

Gingival groove fluid (GCF) is defined as serum transudate when the periodontium is healthy and the inflammatory exudate of periodontal tissues in disease. Exudate is the result of increased permeability of the vessels adjacent to the junctional epithelium and leakage of plasma into the sulcus.[4] Transudate is the result of increased pressure in veins and capillaries, which causes the interstitial fluid to pass through the vessel wall into the sulcus.[5,6] In terms of content, transudate is a protein-poor, watery interstitial fluid, whereas exudate is a more protein-rich structure, including essential plasma proteins and immunologically active components.

Since the early 1960s, it has been suggested that biochemical analysis of GCF may be an effective method for assessing the inflammatory status of gingival tissues.[7,8,9,10] In a human experimental model of gingival inflammation, it has been shown that signs of inflammation are observed when oral hygiene practices are interrupted for three days and that GCF synthesis accompanies clinical signs of inflammation, such as bleeding on probing11. Therefore, GCF is an important source for periodontal disease activity and for evaluating the effectiveness of periodontal therapy.

GCF contains cellular components such as epithelium, bacteria, leukocytes erythrocytes, erythrocytes, viruses and their products.[12,13,14], electrolytes[9,15], bacterial metabolic products[16], host and bacterial enzymes, and enzyme inhibitors such as acid phosphatase, alkaline phosphatase[17], cytokines[18,19,20] and immunoglobulins.[21,22] It has also been found that systemically administered drugs pass into the GCF.[23,24,25]

Gingival Crevicular Fluid Collection Methods

Three basic methods for obtaining GCF have been described[4];

- Capillary tube method
- Gingival sulcus washing method
- Paper strip method
- Capillary tube method

The use of micropipettes allows the collection of fluid through capillary activity. Capillary tubes are inserted into a pocket of standard length and diameter, and the contents are then centrifuged and analyzed.[7,26] After isolation and drying of the area of interest, capillary tubes are placed at the entrance of the gingival groove. The GCF in the sulcus moves towards the tube with capillary activity. By measuring the distance, the GCF moves, the volume collected can be determined.[27] This technique is especially used in individuals with periodontal disease, in whom an increase in GCF volume is expected. An important disadvantage of this method is that the tubes placed in the sulcus and moved in this area may cause trauma.

Gingival Sulcus Washing Method

This method has been applied in two different ways. The basic approach in both applications is to wash the gingival

sulcus with a certain amount of fluid and collect this fluid again. In the first application, the sample area isolated with rolled cottons is washed with a special solution, and the GCF and the fluid delivered to the area are collected with a micro syringe.[4,28,29,30] As a result, the volume and content of the GCF sample obtained may not be accurate.[4] In the other application, acrylic plates containing tubes are prepared specifically for the individual. After washing the gingival groove, GCF and fluid are collected with the tubes in the plates.[30] However, the preparation of individualized plates is a factor limiting the use of this method. In addition, there is a risk of contamination in the lower jaw with both methods.[4]

Paper Strip Method

In this method, paper strips are used to obtain GCF. The technique, which is divided into in-groove and out-of-groove, is the most commonly used GCF collection method today. In the out-of-groove method, the paper strip is placed on the buccal surface of the tooth, close to the sulcus entrance.[9] Due to the position of the paper strip, the possibility of contamination is high.[9] In the in-groove method, the paper strip is advanced until resistance is felt in the sulcus, and the GCF sample is obtained from the sulcus in this way.[20,31,32] However, prolonged sampling time increases the risk of mechanical irritation and contamination.[9,31]

Determination of Gingival Crevicular Fluid Volume by Paper Strip Method

Following GCF collection with paper strips, there are different approaches to determining the volume of fluid obtained.

Microscopic Examination of Wet Areas on Paper Strips

In this GCF volume determination method, the wet area on a paper strip with a known surface area is calculated. The collected strips are stained with ninhydrin, and the wet areas are determined under a microscope.[4,9,33,34,35] In addition, a systemically administered fluorescent dye can be extracted from the gingival sulcus, and the wet areas of GCF samples collected on paper strips can be examined under ultraviolet light.[4,36]

In addition to the difficulty of performing this method at the bedside, there is also the possibility of loss of samples by evaporation before examination.[4]

Weighing Paper Strips

This method is based on weighing paper strips on a precision balance before and after obtaining GCF samples. Even with this method, the volume of GCF can change with evaporation.[4]

Determination of Gingival Crevicular Fluid Volume with Periotron Device

Currently, the Periotron device (Periotron 8000, Oraflow Inc., Plainville, NY, USA) is most commonly used to determine GCF volume. In this fast and sensitive technique, the volume of GCF in paper strips is determined by electrical capacitance changes.[4] For the calibration of the device, liquids with known volumes are applied to paper strips and read by the periotron device, and a calibration curve is obtained as a result. According to this curve, the GCF volume is determined.[37] Factors such as the calibration of the periotron device, the properties of the paper strips used, contamination of the device and the sampling area, evaporation, temperature, and humidity of the environment may affect the determination of the GCF volume.[38]

Factors Affecting the Amount of Gingival Crevicular Fluid

The amount of GCF is higher in the presence of inflammation and increases in proportion to the severity of inflammation.[39,34] Chewing hard foods, tooth brushing, and gingival massage also stimulate GCF flow.[40] Circadian rhythm.[41], sex hormones, and fixed prosthetic restorations have also been reported to increase GCF.[42] Although smoking causes a transient increase in GCF flow, GCF flow decreases in the long term.[43] An increase is also observed during the healing period after periodontal surgery.[44] These factors should be taken into consideration in order to make healthy measurements in GCF acquisition.

Peri-implant Sulcus Fluid

Early and accurate diagnosis of peri-implant diseases is one of the factors that help to prolong the life of dental implants.[45] Different factors, including clinical, biochemical, and microbiological parameters, are used to assess the health of the tissues around the implant and to make an early diagnosis. These factors include peri-implant probing depth, bleeding on probing, suppuration, biochemical analysis of peri-implant sulcus fluid or saliva, microbiological analysis of peri-implant microbiota, and radiographic evaluation of peri-implant bone levels. Peri-implant sulcus fluid (PISF) is a serum-derived, osmotically mediated exudate originating from the gingival vascular plexus and is considered being an analog of the GCF of natural teeth.[46] The contents of GCF and PISF are similar, containing substances from microorganisms in the subgingival and supragingival plaque along with the host.[17] The difference in biomarkers and enzymes in the peri-implant sulcus fluid during the transition from health to disease state provides promising results.[47] In the presence of inflammation, the volume of PISF increases. This is because inflammatory mediators, tissue degradation products, and mineralized tissue components pass into the PISF during inflammation.

PISF has been used in the diagnosis of peri-implant inflammation.[46] Although not widely used in practical applications, PISF analysis is a promising and reliable diagnostic tool.[45]

CONCLUSION

The greatest appeal of GCF as a diagnostic marker is the site-specific nature of the sample. This allows for the correlation of GCF components with clinical assessments. Understanding the components of GCF, including cellular elements, will help to clarify the initial events in the pathogenesis of periodontal and peri-implant diseases and to monitor the disease process. It will also enable new, effective treatment paradigms and strategies to prevent periodontal and peri-implant diseases.

ETHICAL DECLARATIONS

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