



GINGIVAL CREVICULAR FLUID – A REVIEW

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ABSTRACT The existence of gingival crevicular fluid (GCF), a fluid that emerges between the surface of the tooth and the epithelial integument, has been recognized for over many years. The exact nature of the fluid, its origins and composition, has been the subject of controversy. This may be a result of variations in the amount and/or nature of the fluid produced under different clinical conditions and the use of a wide variety of sampling methods. Gingival crevicular fluid (GCF) is a complex mixture of substances derived from serum, leukocytes, structural cells of the periodontium and oral bacteria. The substances present in gingival crevicular fluid possess a great potential for serving as indicators of periodontal disease. Therefore gingival crevicular fluid is treated as a window for noninvasive analysis of periodontitis, taking into account indicators and markers of connective tissue and bone destruction.

KEYWORDS : exudate, periotron, filter paper, periodontitis

INTRODUCTION

The defence mechanism of oral cavity comprises of GCF, leukocytes, saliva, epithelial barrier of the gingival sulcus which are generally effective in controlling the deleterious effect of the heavy concentration of bacteria found in dental plaque. If this balance between host and parasite is slightly changed, the result can be progressive periodontal breakdown. Gingival crevicular fluid (GCF) is a complex mixture of substances derived from serum, leukocytes, structural cells of the periodontium and oral bacteria.¹ The review by Griffiths examines the hypothesis of Alfano which states that in health GCF represents the transudate of gingival tissue interstitial fluid but in the course of gingivitis and periodontitis GCF is transformed into true inflammatory exudate. Gingival crevice fluid (GCF) contains a large repertoire of serum proteins, inflammatory mediators, host cell degradation products and microbial metabolites.

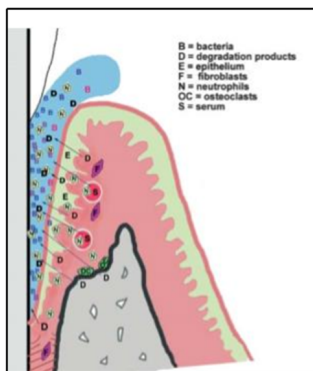


Fig.1. Gingival crevice fluid – a window to periodontal disease. Gingival crevice fluid is composed of substances derived from serum, leukocytes, bacteria, activated epithelial cells, connective tissue cells, and bone cells. Tissue destruction during periodontal inflammation results in production of tissue fragments and growth factors released from tissue stores. All these substances reflect the periodontal disease process and can be potentially used as indicators of periodontal condition.

Figure 1: Gingival crevice fluid

HISTORICAL BACKGROUND

The presence of crevicular fluid has been known since the 19th century. In the late 1950s and early 1960s a series of ground breaking studies by Brill et al. laid the foundation for understanding the physiology of GCF formation and its composition⁸. The GCF studies boomed in the 1970s. Presence and functions of proteins, especially enzymes in GCF were first explored by Sueda, Bang and Cimasoni. In 1974 the first edition of the monograph *The Crevicular Fluid* by Cimasoni was published followed by an update in 1983. This comprehensive review gave a boost to studies on GCF and today research on GCF had increased tremendously.

FORMATION OF GCF

GCF as an inflammatory exudate The initial investigations of GCF attempted to relate its formation to the inflammatory changes in the connective tissues underlying the sulcular and junctional epithelia. These changes were primarily an increased permeability of the blood vessels, which were induced by chemical or mechanical means.

Early experiments² showed that systemically administered fluorescein appeared in the GCF collected from healthy gingival crevices in dogs.³ Since the other oral epithelia had not allowed the passage of the fluorochrome it was concluded that differences in permeability must exist between these oral epithelia and the epithelium lining the gingival pocket. Even so, the studies of Brill⁴ emphasized the possible beneficial effects of GCF and he postulated that GCF was an important component of the protective mechanisms of the crevicular region. This concept was supported by the flushing effect of GCF, which was shown to be capable of removing carbon particles and bacteria which had been introduced into the gingival crevice.⁵

This extensive work was further supported by the equally comprehensive studies of Egelberg⁶⁻⁸ who investigated the histology of the vasculature underlying the sulcular and junctional epithelia.

GCF as a transudate of interstitial fluid

The work of both Brill and Egelberg seemed to suggest that the production of GCF was primarily a result of an increase in the permeability of the vessels underlying junctional and sulcular epithelium. An alternative theory arose from the work of Alfano⁹ and

from the hypothesis postulated by Pashley¹⁰ which suggested that the initial fluid produced could simply represent interstitial fluid which appears in the crevice as a result of an osmotic gradient. This initial, pre-inflammatory fluid was considered to be a transudate, and, on stimulation, this changed to become an inflammatory exudate.

METHODS OF COLLECTION

The methods of collection may be broadly divided into the intracrevicular and the extra-crevicular techniques. The intracrevicular method is the method used most frequently and can be further subdivided depending upon whether the strip is inserted just at the entrance of the crevice or periodontal pocket¹¹ or whether the strip is inserted to the base of the pocket or until minimum resistance is felt¹².

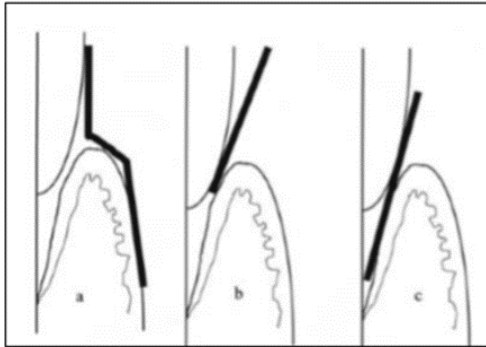


Figure 2:- illustration of the position of papers for the filter paper strip method of collection (a) extracrevicular method;(b) intracrevicular method 'superficial';(c)intracrevicular method 'deep'

GINGIVAL WASHING METHODS

In this technique the gingival crevice is perfused with an isotonic solution, such as Hanks' balanced salt solution. The fluid collected then represents a dilution of crevicular fluid and contains both cells and soluble constituents such as plasma proteins.

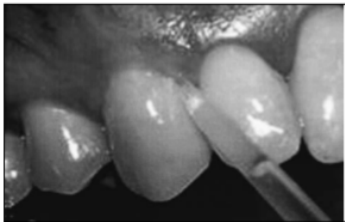


Figure 3:- CAPILLARY TUBING OR MICROPIPETTES

Following the isolation and drying of a site, capillary tubes of known internal diameter are inserted into the entrance of the gingival crevice. GCF from the crevice migrates into the tube by capillary action and because the internal diameter is known the volume of fluid collected can be accurately determined by measuring the distance which the GCF has migrated.¹³

Figure 4:-



ABSORBENT FILTER PAPER STRIPS

There are considerable variations in the application of the filter paper strip method of collection. The

Periotron reading	Level of gingival inflammation	Gingival index
0 – 20	Healthy	0
21-40	Mild	1
41-80	Moderate	2
81-200	Severe	3

principal variations are with respect to not only the method and timing of sample collection, but also the means of estimating the volume of sample collected.

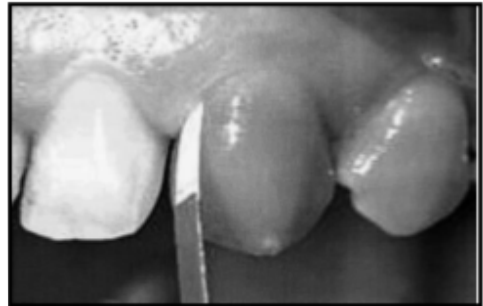


Figure 5:- METHODS OF ESTIMATING THE VOLUME COLLECTED SIMPLE LINEAR MEASUREMENT

- Amount of GCF collected on strip was assessed by the distance the fluid had migrated up the strip.

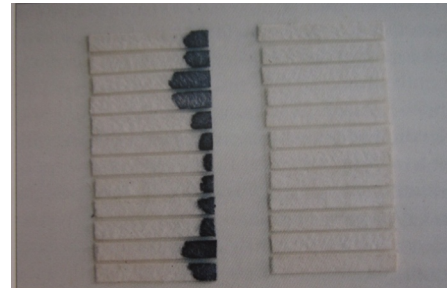


Figure 6:- PERIOTRON

An electronic method has been devised for measuring gingival fluid absorbed on paper strips by Harco electronics called Periotron® (Dental product division Winnipeg, Manitoba, Canada).

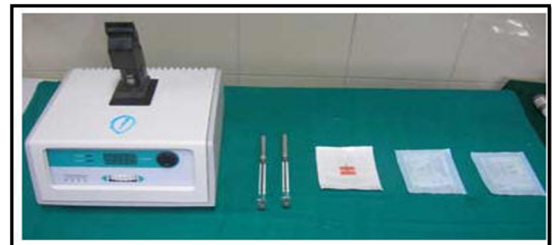


Figure 7:- Periotron CLINICAL SIGNIFICANCE OF GINGIVAL CREVICULAR FLUID

CIRCADIAN PERIODICITY

There is a gradual increase in GCF amount from 6 am to 10 pm and decrease afterward. A daytime variations of interleukin-1beta in gingival crevicular fluid throughout the day, with the lowest concentrations and total amounts in the morning and the highest in the evening.

SEX HORMONE:

Female sex hormone increase GCF flow, probable because they enhance vascular permeability, pregnancy, ovulation, and hormonal contraceptive all increase the production of fluid.

MECHANICAL STIMULATION:

Chewing and vigorous gingival brushing stimulate the flow of GCF. Even the minor stimuli represented by intrasulcular placement of paper strip increases the production of fluid.

SMOKING :

Smoking produces immediate and transient but marked increase in flow.

PERIODONTAL THERAPY:

There is increase in gingival crevicular fluid production during healing period after periodontal therapy. The study suggest that a wider area of

keratinized gingival favours physiological behavior of the gingival sulcus by a better dissipation of GCF; a close proximity of gingival margin and alveolar mucosa influences the dissipation of tissue fluid through alveolar mucosa, which is more permeable and mobile, impairing primary defense of gingival sulcus by concentration of GCF.¹⁴

IMPACT AND SULCULAR FLUID:

The relevance of the component of crevicular fluid around dental implant is now recognized as diagnostically significant indeed, because the anatomy of the soft tissue to implant interface is reasonably similar to teeth with respect to epithelial attachment and the presence of peri-implant sulcus, there is no reason to expect that peri-implant sulcular fluid could not provide useful information regarding integration or otherwise, of osseointegrated dental implant.

COMPOSITION OF GINGIVAL CREVICULAR FLUID

Cellular Elements: Cellular elements found in GCF include bacteria, desquamated epithelial cells, and leukocytes (PMNs, lymphocytes, monocytes/macrophages), which migrate through the sulcular epithelium.

Electrolytes: Potassium, sodium, and calcium have been reported to be found in GCF.

Organic Compounds: Both carbohydrates and proteins have been investigated. Glucose hexosamine and hexuronic acid are two of the compounds found in GCF.

Enzymes and Other Compounds Reported in Gingival Crevicular Fluid Acid phosphatase, Alkaline phosphatase, α -Antitrypsin, Arylsulfatase, Aspartate aminotransferase, Chondroitin sulfatase, Citric acid, Cystatins, Cytokines (interleukins), IL-1 α , IL-1 β , IL-6 and IL-8, Endopeptidases, Fibrinolysin, Glucosidases, Hemolysin, Hyaluronidase, Iminopeptidases, Immunoglobulinases, Trypsinlike enzyme.

THE TOTAL PROTEIN CONCENTRATION OF GCF

The biochemical composition of gingival crevicular fluid (GCF) has received much attention recently because of the need for a reliable indicator of the health status of individual periodontal sites (Poison & Goodson 1984, Fine & Mandel 1986, Curtis et al. 1988). The components of GCF may be assumed to be drawn from 4 main sources:

- (1) breakdown of the host epithelial and connective tissues
- (2) products of host cells in the periodontium
- (3) plasma derived molecules
- (4) products derived from the subgingival microbial plaque.

GCF AS A PERIODONTAL DIAGNOSTIC INDICATOR

Curtis et al stated that "markers of disease" might encompass three separate categories:

- 1) Indicators of current disease activity
- 2) Predictors of future disease progression
- 3) Predictors of future disease initiation at currently healthy sites.

CELLULAR & HUMORAL ACTIVITY IN GCF

- Analysis of GCF has identified cellular & humoral response in both healthy individuals & those with periodontal disease.
- The cellular immune response - includes the appearance of cytokines in GCF - no clear
- evidence of a relationship between them & disease.
- Interleukin-1 α & -1 β are known to increase the binding of PMNs & monocytes to endothelial cells, stimulate the production of PGE₂ & release of lysosomal enzyme & stimulate bone resorption.

COMMERCIALY AVAILABLE DIAGNOSTIC KIT

- 1) Perio-Check - Neutral Proteinases like collagenases - Approved by FDA
- 2) PerioGard™ - AST
- 3) Progno-Stik- Elastase - Not Approved by FDA and ADA
- 4) Biolise - Elastase
- 5) PocketWatch™ - AST
- 6) TOPAS (TOXICITY PRESCREENING ASSAY) - Bacterial toxins and Proteins
- 7) DipStick test - MMP-8

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