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Recent Concepts Regarding Gingival Crevicular Fluid:

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ABSTRACT:

Gingival crevicular fluid (GCF) is an inflammatory exudate derived from the periodontal tissues. It is composed of serum and locally generated materials such as tissue breakdown products, inflammatory mediators, and antibodies directed against dental plaque bacteria. Gingival crevicular fluid (GCF) contains a rich array of cellular and biochemical factors which have been shownto indicate the metabolic status of the periodontium[1].Since GCF is composed of serum and locally generated components such as tissue breakdown products, inflammatory mediators and antibodies in response to oral microorganisms present in the dental biofilm thus it offers great potential to reflect the response that the cells and periodontal tissues promote to attempt regaining homeostasis and also how certain periodontopathogens co-opt these response mechanisms to promote bacterial survival within the gingival crevice and pocket[1].

KEYWORDS: Gingival crevicular fluid, Oral fluid, Gingival sulcus, Inflammatory exudate, Transudate.

INTRODUCTION:

Easily collected and containing local and systemic-derived biomarkers, oral fluids may offer the basis for patient-specific diagnostic tests for periodontal disease. Gingival crevicular fluid (GCF) is a physiological fluid as well as an inflammatory exudate originating from the gingival plexus of blood vessels in the gingival corium, subjacent to the epithelium lining of the dentogingival space[2]. The presence of fluid in the gingival crevice has been described since the nineteenth century. Originally, most investigators classified GCF as an inflammatory exudate[1]. However, there is evidence to suggest that GCF from clinically normal tissue is an altered serum transudate that only becomes an inflammatory exudate when disease is clinically present. The recognition in the last decade that neutrophils migrate into the periodontal crevice even in health tends to obfuscate the characterization of GCF as an inflammatory exudate vs a physiologic transudate[1]. Furthermore, it is clear that the composition of the GCF differs in terms of microbial composition and the concentration and composition of molecular biomarkers when one compares healthy sites from diseased individuals vs healthy sites from periodontally healthy individuals[3]. Additionally, there are clear changes in GCF composition during disease progression and certain mediators can be used to predict future patient-based or site based disease outcomes. The flow of fluid into the gingival crevice is typical of

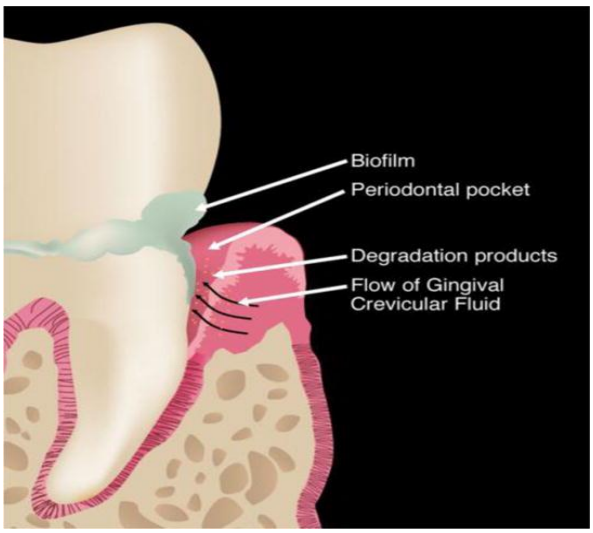
inflammation and accompanied by an increase in cellular infiltrate[3]. Neutrophils, which are considered to be the major cellular defense system in the gingival crevice, leave the capillary network in the underlying connective tissue and migrate through the junctional epithelium into the crevicular space, where they accumulate at the interface of the subgingival plaque and the gingival epithelium. This migration occurs along with chemotactic gradients established by both bacterial components and activated host messengers. Approximately 75–80% of neutrophils isolated from the GCF are viable cells and it would appear that crevicular neutrophils are capable of ingesting and killing microorganisms and utilize their armamentarium of antibacterial molecules[4.] However the neutrophil functional capability at sulcular/pocket microenvironment is still a controversial topic. Nonetheless, the presence of an IL-8 gradient in health that serves to recruit neutrophils into the crevice coupled with the observation that the junctional epithelium lacks tight junctions suggests that neutrophil egress into the crevice in health is a physiological process that likely results in concomitant fluid flow.

Gcf:Transudate Or Exudate:

Although the importance of GCF has been recognized for decades, historically the origin and function of this fluid has been a subject of controversy. Most of the controversy relied on whether this fluid is the result of a physiological or pathological process[5]. Early investigations demonstrated that GCF is present in the healthy gingival tissues.However, Loe & Holm-Pedersen reported that healthy gingival crevices do not exhibit GCF flow.The authors suggested that GCF is an inflammatory exudate, but if it is present prior to clinically detectable signs of inflammation, it would appear to be derived from healthy gingival tissues. Although the GCF has an ionic composition comparable to an inflammatory exudate, its protein composition is considerably lower for an inflammatory exudate[1].

Theories Of Gcf Origin:

In 1974, Alfano described a theory related to the origin of GCF.The theory is based on the premise that GCF arises from two distinct mechanisms: the generation of a standing osmotic gradient, and the initiation of classical inflammation[6]. The gingival crevicular fluid originates from the vessels of the gingival plexus of blood vessels and flows through the external basement membrane and the junctional epithelium to reach the gingival sulcus[1.] It has been shown that GCF can be isolated from a healthy sulcus, although only in small amounts. In the healthy periodontium, GCF represents the transudate of gingival tissue interstitial fluid produced by an osmotic gradient[5].However, leukocytic infiltrates are seen throughout the junctional epithelium and PMNs can always be found in the sulcus, even in clinically healthy situations where the flow of GCF is relatively low[6].



During the early investigations about the origin of gingival fluid, several processes were postulated to explain how fluid might be transported across epithelial membranes, including theories of hydrostatic

filtration, active transport and classical osmosis. Diamond and Tormey proposed a model for fluid transport based on the observation on the morphological changes occurring during in vitro transport of water across bladder gallbladder epithelium[7]. Basically, it was noted that in conditions where water transport was maximal, the intercellular spaces were widely distended and conversely when water transport was partially inhibited, intercellular spaces were restricted. Diamond and Tormey postulated[7] in 1966 that there was a standing osmotic gradient within the intercellular spaces and that osmotic equilibrium was reached as water is osmotically pulled across the cell membrane[7].

Model Bypashley (1976):

GCF production is governed by the ***passage of fluid from capillaries into the tissues(capillary filtrate)[1]***

Removal of fluid is by ***lymphatic system***.

when the role of capillary fluid exceeds that of lymphatic uptake, the fluid accumulate as edema and leave the area as GCF[1].

FUNCTIONS OF GCF:

1. Exert antibody activity in defense of gingiva[7]
2. Possesses anti-bacterial property
3. Cleanses materials from the gingival sulcus
4. Contains plasma proteins that may improve the adhesion of epithelium to tooth surface.

Methods Of Collection Ofgcf:

1. Absorbent filter paper strips
2. Pre-Weighed twisted threads
3. Micro-pipettes/Capillary tubings
4. Crevicular washings

Absorbent Filter Paper Strips:

It has been reported that recovery of proteins in gingival crevicular fluid samples varies considerably according to the type offilterpaper on which the gingival crevicular fluid sample is collected[8],butthis problem is likely to be less of an issuenow as mostresearchersappearto use*PERIOPAPERS*[1].These are pre-sterilized filter paper strips ofstandardsizethatcan absorb fluid volumes of up toapproximately1.2 l.

METHODS OFPLACEMENT OF FILTER PAPERSTRIPS:

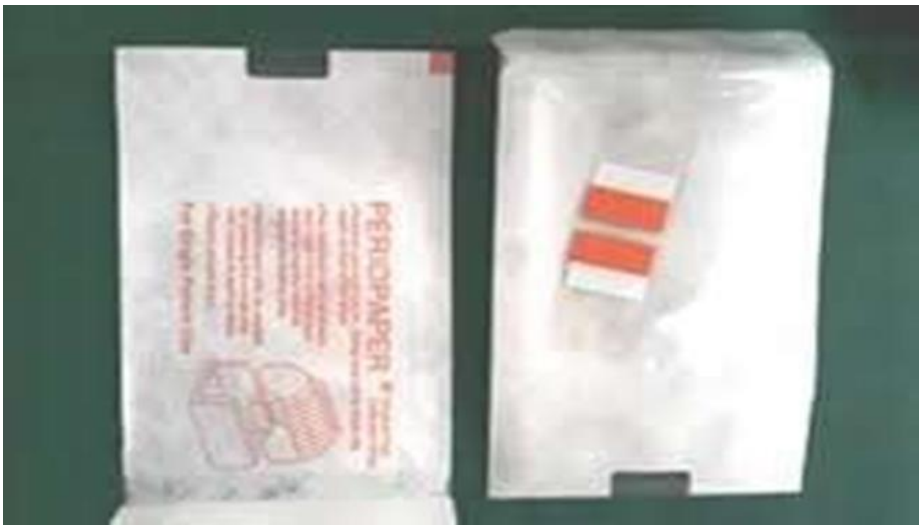
***Brill'stechnique*:**

Strip is inserted until resistance is felt,but this by itself induces a degree of irritation that can itself trigger the oozing of fluid.[2]

Loe And Holm-Pederson Technique:

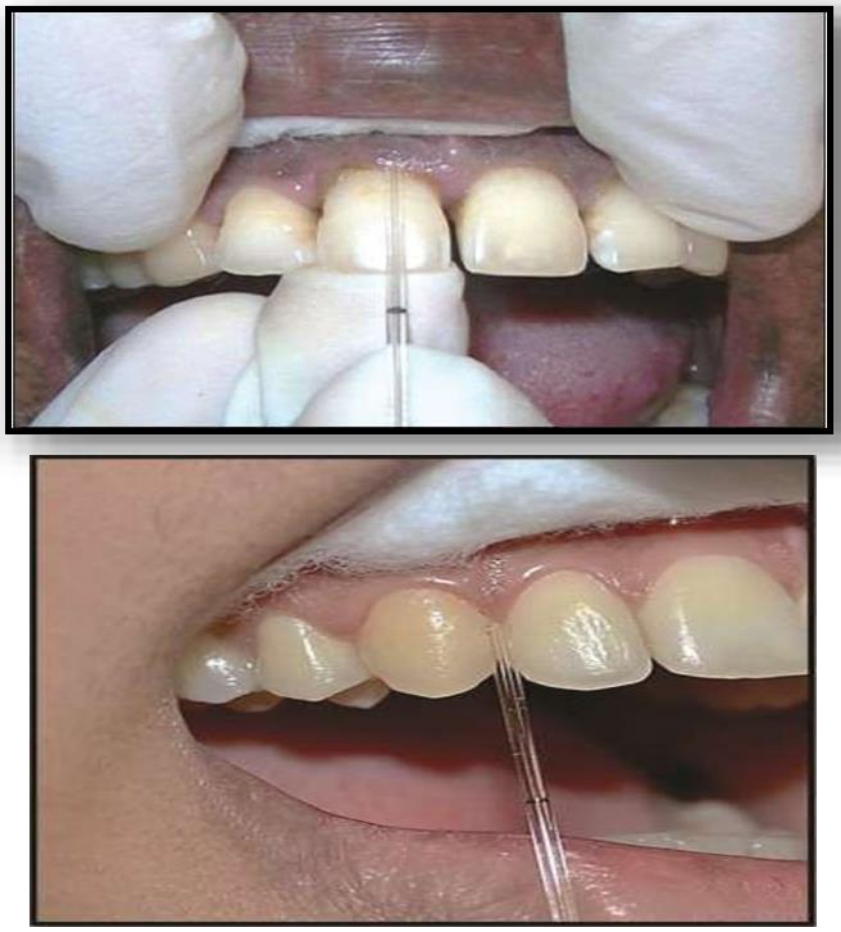
To minimize the irritation,they placed the filter paper strips just at the entrance of

the pocket or over the pocket entrance. In this way the fluid seeping out is picked up by the strip,but the sulcular epithelium will not come in contact with the paper[9]. Typically, Periopapers are placed just into the entranceofthe sulcus/pocket until mild resistanceis felt (i.e.utilizingthe intracrevicular method of placement).Attempts to position Periopapers to the known depth of a particular periodontal pocket are typically unsuccessful because the paper has a tendency to crumple up under the pressure of insertion as it becomes increasingly saturated withfluid[3]. Furthermore, contamination with blood is also very commonif trying to position a Periopaper to the fulldepth of apocket.



Preweighted Twisted Threads:
This method was used by **Weinstein etal.*Threads were placed in the gingival crevice*** around the tooth and the amount of fluid collected wasestimated by the weight of samplethread[1].The thread were weighed before collection within a sealed micro-centrifugation plastic tube and the weighing was repeated immediately after thecollection.

Micro-Pipettes/Capillary Tubings:
Krasse and Egelberg (1962)were first to utilizecapillary tubing[4]. This permits the collection of fluid by capillaryaction.After isolation and drying of the collection site,capillary tubes of known diameter is inserted into the entrance of the gingival crevice. As diameter is known the GCF can be calculated by measuring the distance to which the GCF has migrated and the content was centrifuged and analysed.



Crevicular Washings:

Gingival sulcus is perfused with an isotonic solution suchas ***Hank's balanced salt solution*** of fixedvolume.Two methods are used: one is the simplest method involving the ***instillation and re-aspiration of 10 µl of Hank's balancedsalt solution at the interdental papilla[9]. It is repeated 12 timestoallow thorough mixing oftransport solution andGCF.***Second method is more complicated which involves the construction of a customized **acrylic stent** that isolates the gingival tissue from the rest of the mouth. Thetissues are irrigated with a saline solution, using a peristaltic pumpand the diluted GCF isremoved[3.]

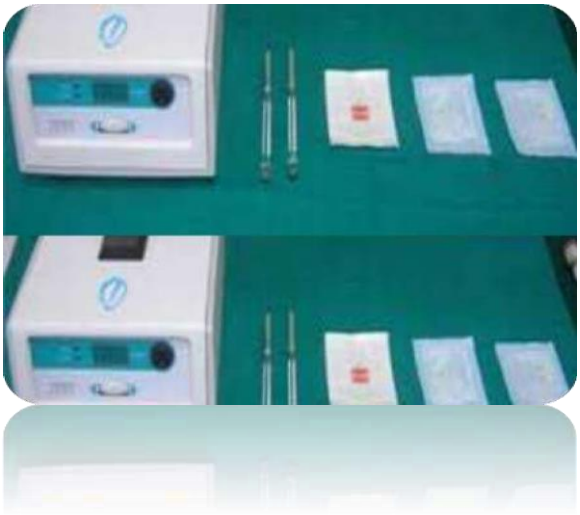
METHODS OF ESTIMATINGTHE VOLUME COLLECTED:

1. Amount on the strip is assessed by the **distancethe fluidhas migrated up thestrip.**
2. More accurate method is assessing the **area of filterpaper wettedby GCFsample.**
3. Weighing the strips before and aftersample collection.

Wetted area can be made more visible by staining with ninhydrinwhich produces a purple color in the areawhere GCFhadaccumulated (***Cimasoni G,1983)[10].***

Electronic Method:

It has been devised for measuring the fluid collected ona"blotter" (Periopaper), employingan electronic transducer.The wetness of the paper strip affects the flow of an electric current and gives a digital read-out.



Periotron:
The volume of gingival crevicular fluid absorbed byPeriopaper strips can be quantified using a Periotrondevice.Periotron is an electronic instrument that measures the effectof wetness of filter paper strips on thecapacitance betweenthe'jaws'of the device[10], between which thefilter paper is placedafterthe samplehas beencollected.

Principle:
Functions on the principle of the capacitator[8],i.e. it measures the electrical capacitance of the wet filter paper strip placed between the jaws of the instrument.The electric field created between the two opposing charges on the jaws induces polarity of the molecules which reduces the potential difference between the plates and increase the capacitance.

PROBLEMS DURING GCF COLLECTION:
1.Contamination
2.Small Sample Size
3.Sampling Time
4.Volume Determination
5.Recovery Of Strips

Gcf As A Diagnostic Tool:
Collection of GCF is non-invasive and therefore this approach has been extensively explored in the search for potential diagnostic biomarkers of periodontal disease[10]. As a result of interaction between the bacterial biofilm and thecells of the periodontal tissues, gingival crevicular fluid appearsasan attractive oral diagnostic fluid due to itsease ofcollectionandallowing for sampling of multiple sites within theoralcavitysimultaneously[3].Host susceptibility is a critical determinant in periodontal disease pathogenesis giving the inflammatory mediator levels present in GCF an important value for evaluating risk for disease activity. GCF IL-1β and IL-6 were significantly associated with deep pocket depths and severe gingival inflammation. The use of GCF alone or clustered with periodontal pathogens, serum, and saliva biomarkers suggests potential diagnostic value to identify periodontal disease activity and response to therapy. Although GCF IL-1β demonstrated a significant difference at baseline between progressing and stable patients, it was not a good predictor of periodontal disease progression[9].

CONCLUSION:

GCF as a diagnostic and prognostic tool has been explored since the initial studies on GCF which aimed to demonstrate that the flow of gingival fluid was sufficiently indicative of the inflammatory state of the periodontal tissues[10]. metabolomic analyses of GCF that measures microbial and host interactions associated with the onset and progression of periodontal disease has the potential utility to expand our understanding and improve the landscape for the discovery of diagnostic, prognostic and therapeutic markers.

REFERENCES:

1. Barros SP, Williams R, Offenbacher S, Morelli T. Gingival crevicular fluid as a source of biomarkers for periodontitis. Periodontology 2000. 2016 Feb;70(1):53-64.
2. Alfano MC. The origin of gingival fluid. Journal of theoretical biology. 1974 Sep 1;47(1):127-36.
3. Dwarakanath CD. Carranza's Clinical Periodontology-Ebook: Third South Asia Edition. Elsevier Health Sciences; 2019 Aug 1.
4. Griffiths GS. Formation, collection and significance of gingival crevice fluid. Periodontology 2000. 2003 Feb;31(1):32-42.
5. Subbarao KC, Nattuthurai GS, Sundararajan SK, Sujith I, Joseph J, Syedshah YP. Gingival crevicular fluid: An overview. Journal of Pharmacy & Bioallied Sciences. 2019 May;11(Suppl 2):S135.
6. Goodson JM. Gingival crevice fluid flow. Periodontology 2000. 2003 Feb;31(1):43-54.
7. Champagne CM, Buchanan W, Reddy MS, Preisser JS, Beck JD, Offenbacher S. Potential for gingival crevice fluid measures as predictors of risk for periodontal diseases. Periodontology 2000. 2003 Feb;31(1):167-80.
8. Cimasoni G. The crevicular fluid. Monogr. oral Sci.. 1974;3:1-22.
9. Egelberg J. Cellular elements in gingival pocket fluid. Acta Odontologica Scandinavica. 1963 Jan 1;21(4):283-7.
10. Golub LM, Kleinberg I. Gingival crevicular fluid: a new diagnostic aid in managing the periodontal patient. Oral sciences reviews. 1976(8):49-61.