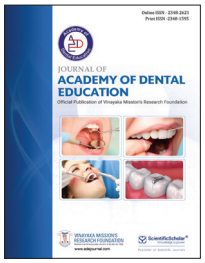
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Review Article

Cross-linked carboxyl-terminal telopeptide of type I collagen – A classic marker for bone resorption

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ABSTRACT

Periodontitis is a common periodontal disease encountered worldwide; it is a chronic inflammatory condition that eventually leads to the destruction of supporting periodontal structures. Periodontal biomarkers are authentically important for assessing the activity of the disease and its treatment outcomes. Cross-linked carboxyl-terminal telopeptide of type I collagen (ICTP) represents one member of a significant group of molecules that are largely associated with bone resorptive diseases. Gingival inflammation can be distinguished from progressive periodontitis when ICTP can be applied clinically, as it is an existing biomarker specific to bone degradation. The present review article elaborates the role of ICTP as an implicit bio marker in estimating periodontal health and disease.

Keywords: Biomarker for periodontal bone resorption, Cross-linked carboxyl-terminal telopeptide, Type I collagen

INTRODUCTION

Periodontitis is characterized by persistent inflammation that ultimately results in the breakdown of the supporting periodontium.[1] One common indication of periodontitis is the loss of alveolar bone. Measurements of bleeding on probing, clinical attachment loss, and pocket depth (PD) are conventional methods of periodontal health assessment.[1,2] By the time of diagnosis as periodontitis, there is a significant amount of bone loss that has already occurred.[3] The above-mentioned clinical parameters are pivotal in identifying the periodontal breakdown, but are not helpful in early detection before the progression of the active breakdown of both the soft and hard tissues of the periodontium.

The inability of the conventional measures to unquestionably detect a case of gingivitis that is advancing and may eventually result in periodontitis is another drawback.[4] To evaluate the activity of the illness and the results of its therapy, periodontal biomarkers are very significant. Type I collagen's cross-linked carboxyl-terminal telopeptide (ICTP) belongs to a class of pyridinoline cross-links that are unique to cartilaginous and osseous tissues. Hence, it can be said, the presence of ICTP is indicative of bone diseases. ICTP, considered a hallmark for bone destruction, can be used to differentiate gingivitis from progressive periodontitis.[1]

In many systemic metabolic bone diseases, ICTP concentration is currently utilized as a diagnostic indicator of active bone resorption, conditions such as primary hyperparathyroidism, myxedema,

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thyrotoxicosis, and postmenopausal osteoporosis. These biomarkers are monitored, which aids in defining treatment plans and tracking the course of the illness. Such a biomarker will significantly improve the outcome of periodontal treatment by improving the prediction and treatment plan. ICTP and its relevance in tracing the disease progression of an active periodontal breakdowns are explained elaborately in this narrative review.

METHOD OF ESTIMATION OF ICTP IN SALIVA

Sterile micropipettes will be used to collect saliva. Patients will be advised to abstain from food and liquids for 1 h before the sample collection. Subjects will also be requested to rinse their mouths with de-ionized distilled water. The collected saliva will be entire, unstimulated saliva. In addition, the samples will be sent to the storage location wrapped in a dry ice box.[1] To study the saliva samples, the collected saliva will be centrifuged at 2800 rpm. The supernatant will be transferred to the cryotubes without disturbing the pellets formed.[1]

METHOD OF ESTIMATION OF ICTP IN GINGIVAL CREVICULAR FLUID (GCF)

GCF will be collected using sterile paper strips.[1] Periopaper (Oraflow Inc., NY and USA) will be carefully inserted into the gingival sulcus. After the strips are collected, Periotron will be used for the assessment of the volume of GCF. The samples will be tested using an enzyme-linked immunosorbent assay kit for human ICTP, which uses a double-antibody sandwich approach to detect human ICTP.[1]

APPLICATIONS IN CLINICAL PERIODONTOLOGY

With the aid of periodontal biomarkers, treatment outcomes and disease activity are evaluated, treatment regimens are materialized, and the disease's progression is tracked.[5] Due to osteoplastic resorption and the collagen matrix in periodontitis circumstances, pyridinoline, deoxypyridinoline, and amino and carboxy terminal cross-linked telopeptides of type I collagen also enter the bloodstream.[6] These molecules are released into the bloodstream and cannot be utilized again in the production of collagen as a result of the breakdown of the collagen matrix in response to periodontal disorders. The carboxy-terminal telopeptide sections of type I collagen cross-linked by pyridinoline or deoxypyridinoline are used to derive the pyridinoline-cross-linked carboxy-terminal telopeptide of type I collagen (ICTP).

Procollagen synthesis occurs, and after its termination, the collagen fibrils will undergo post translation and eventually be released into the extracellular matrix. This results in the creation of cross-linkage in type I collagen chains between the telopeptide regions due to the presence of lysyl oxidase.[1]

Recently, a number of investigations have been conducted to look at C-telopeptides in GCF. In accordance with studies, ICTP is dynamically correlated with radiographic bone level and PD. They were particularly advanced in periodontal sites than in non-periodontal sites.[7] The GCF levels of pyridinoline cross-links (ICTP and deoxypyridinoline) dramatically rose as attachment loss and osteoclastic bone resorption progressed in a ligature-induced experimental periodontitis investigation in dogs (Giannobile *et al*. 1995, Shibutani *et al*. 1997).[8,9]

LACTATION AND PREGNANCY

In comparison to mothers who are not nursing, there is an increase in the biochemical indicators of bone turnover during the 1st month of breastfeeding. The following indicators have been studied: Amino-terminal telopeptide of procollagen 1 (P1NP), bone alkaline phosphatase, cross-linked amino-terminal telopeptide of procollagen 1 (NTX), carboxy-terminal telopeptide of type 1 collagen (1CTP), cross-linked carboxy-terminal telopeptide of type 1 collagen (CTX), deoxypridinoline, and hydroxyproline are indicators of bone resorption.[10] Women who stop breastfeeding after giving birth exhibit certain changes.

In breastfeeding mothers who continue to breastfeed for 18 months or more, the concentrations of bone turnover indicators decreased after 6–12 months.[10]

CONCLUSION

Periodontal disorders are inflammatory problems brought on by bacterial plaque in the tissues that support teeth. Common threat factors include smoking, hereditary vulnerability, poor maintenance of oral hygiene, and systemic diseases like diabetes. Intervention of periodontal disease at its earliest can prevent irreversible changes to the periodontium due to active disease. Early detection and efficient treatment are essential for maintaining periodontal health and slowing the progression of the disease. When the severity of periodontal disease increases, the blood's concentration of ICTP products will also increase.

ICTP is thus a particular biomarker of the degradation of periodontal tissues. Bacterial collagenase activity will result in the breakdown of ICTP. ICTP is released due to bone destruction in periodontitis. Whenever ICTP levels increase, there is a decrease in the patient response to treatment; thereby, decrease in ICTP would be indicative of decreased destruction of bone and improvement in response to treatment. Clinical features and visible periodontal infections are strongly correlated with ICTP, which is also a good predictor of future loss of alveolar bone and attachment.

Hereby, it could be stated that ICTP is unique to alveolar bone loss and hence stamps its usefulness in deploying prompt periodontitis diagnosis. ICTP can be employed as an essential diagnostic marker for the recognition and identification of periodontitis due to its specificity to pyridinoline, which cross-links a byproduct of alveolar bone degradation.

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