Assessment of MMP levels in GCF and in peri implant sulcular fluid in healthy, and peri-implantitis patients

[1]Dr. Uzma Talath, [2]Dr. Aftab Nawab, [3]Dr. Suruchi Singh, [4]Dr. Kadambari Padmanabhan, [5]Dr. Sajid. T. Hussain, [6]Dr. Nitin Bhagat

[1]MD Biochemistry, Davanagere, Karnataka, India
[2]Reader, Department of Periodontics & Implantology, College of Dental Sciences, Davanagere, Karnataka, India
[3]3rd year post graduate student, Department of Prosthodontics, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar, India
[4]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
[5]Associate Professor, Department of Periodontics, Sree Balaji Dental College and Hospital, Chennai, Tamil Nadu, India
[6]Associate Professor and PhD Scholar, Department of Oral and Maxillofacial Surgery, School of Dental Sciences, Sharda University, Greater Noida, India

Corresponding author: Dr. Uzma Talath,

ABSTRACT

Background: this study was conducted to carry out the assessment of MMP levels in GCF and in peri implant sulcular fluid in healthy, and peri-implantitis patients.

Material and methods: A total of 100 participants were included in this investigation. Each person supplied comprehensive medical and dental histories. None of the subjects had recently taken antibiotics or painkillers, and none had any systemic illnesses. Nobody in the study had recently received periodontal treatment. Only nonsmokers were included in this study. Two groups of subjects had been formed. 50 healthy participants made up the first group, and 50 peri-implantitis patients made up the second.

Results: The mean level of MMP-8 in PISF was high and reached 36.98 ng/mL, whereas the mean MMP-8 level in GCF in subjects with healthy periodontium was 6.74 ng/mL.

Conclusion: Monitoring of MMP-8 levels in PISF may aid in early diagnosis of peri-implantitis, prior to clinical symptoms, which may enable prompt initiation of the necessary treatment.

Keywords: collagenase, MMP, GCF, peri-implantitis

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INTRODUCTION

Implants have been used for replacement of lost natural teeth successfully both in periodontally healthy individuals as well as in patients with history of periodontitis [1]. However, in both cases Peri-Implantitis (PI) can develop as a biologic complication if health of mucosal structures surrounding implants cannot be optimally maintained. Based on several studies, periodontitis patients may be more at risk of PI than periodontally healthy [2–5]. Smoking is also regarded as a risk factor for biologic implant complications [4,6].

The implant-bone interaction depends on many factors, including properties of the material from which the implant is made [7]. Another important factor is the quality of the implant surface—its chemical, physical, and mechanical features [8]. It has been shown that the development of the surface of titanium implants increases the potential of biomechanical

contact at the implant-bone connection and affects the rate of protein adsorption [9]. The roughness of implant surface also modulates the adhesion of osteoblasts, increases their enzymatic activity, and affects the amount and type of proteins synthesized by them [10]. Clinical studies conducted in recent years showed that the plain etched and sandblasted surface of the implants may sometimes cause the formation of peri-implantitis [11].
Hence, this study was conducted to a carry out the assessment of collegenase activity and MMP levels in GCF and in peri implant sulcular fluid in healthy,and peri-implantitis patients.

MATERIAL AND METHODS

A total of 100 participants were included in this investigation. Each person supplied comprehensive medical and dental histories. None of the subjects had recently taken antibiotics or painkillers, and none had any systemic illnesses. Nobody in the study had recently received periodontal treatment. Only nonsmokers were included in this study. Two groups of subjects had been formed. 50 healthy participants made up the first group, and 50 peri-implantitis patients made up the second.
The supragingival plaque was thoroughly removed before GCF collection. Samples of GCF were taken at the mesiobuccal location. The sampling locations were cushioned with cotton rollers and allowed to air dry slowly. Sterilized PerioPaper strips were used to obtain GCF samples; they were put into the gingival crevice, held there for 30 seconds, and then removed. Strips that appeared to be visually blood-contaminated were discarded, and mechanical discomfort was avoided. Strips were put in Eppendorf vials after GCF collection and promptly frozen at 80°C until usage.
Clinical examinations of the group of patients with implants were performed after removal of the supraconstructions. Sampling of PISF was performed minimum 18 months following the surgery using sterile PerioPaper strips that were inserted into the gingival crevice until mild resistance was felt and left in place for 30 s. The paper points were then transferred into Eppendorf tubes and then immediately stored in a temperature of −80°C.
Utilizing SPSS software, the statistical analysis for this study was carried out. To examine relationships between MMP-8 level and bone quality and between MMP-8 level and implant functioning time, Spearman's rank correlation coefficient was used. The Shapiro-Wilk test was used to determine whether the distribution was normal. The Mann-Whitney U test was used to compare the levels of MMP-8 in GCF and PISF. Statistical significance was defined as a P value 0.05.

RESULTS

Table 1: number of subjects in the two groups.

Groups	Number of subjects	Percentage
Group 1 (control)	50	50%
Group 2	50	50%
Total	100	100%

There were 50 subjects in both the groups.

Table 2: gender-wise distribution of subjects

Gender	Number of subjects	Percentage
Males	40	40%
Females	60	60%
Total	100	100%

There were 40 males and 60 females in total.

Table 3: mean MMP-8 levels in GCF as well as PISF of healthy as well as peri-implantitis subjects, respectively.

Groups	Mean MMP-8 levels (ng/Ml)
Group 1 (control)	6.74
Group 2	36.98

The mean level of MMP-8 in PISF was 36.98 ng/mL, whereas the mean MMP-8 level in GCF among subjects with healthy periodontium was 6.74 ng/mL.

DISCUSSION

Periodontitis and peri-implantitis, globally common infection-induced oral inflammatory disorders of teeth and dental implants supporting soft and hard tissue, i.e., periodontium and peri-implatium, involve destruction of both soft and hard tissues, as active periodontal and peri-implant degradation (APD). Periodontal/peri-implant tissues are mainly made up of type I collagen. The proteolytic enzyme mainly responsible for the active periodontal/peri-implant soft and hard tissue degeneration (APD) is matrix metalloproteinase (MMP-8), also known as collagenase-2 or neutrophil collagenase. MMP-8 is a member of the MMP family. Structurally related but genetically distinct MMPs are Ca2+- and Zn2+-dependent endopeptidases capable of degradation of almost all extracellular matrix and basement membrane protein components both in physiologic repair and pathologic destruction of tissues, such as a breakdown of extracellular matrix in embryonic development, wound healing, and tissue remodeling [12].

The MMP family is divided into six protease groups: collagenases (MMP-1, MMP-8, and MMP-13), gelatinases (MMP-2 and MMP-9), stromelysins (MMP-3, MMP-10, and MMP-11), matrilysins (MMP-7 and MMP-26), member-type MMPs (MMP-14, MMP-15, MMP-16, MMP-17, and MMP-12), and other nonclassified MMPs, given their auxiliary contrasts [13]. Among all of these groups, the collagenase group is of particular relevance in periodontal disease as it can efficiently cleave native collagen fibers I, II, and III. MMP-8 has been categorized under the interstitial collagenase subgroup of the MMP family. Activities of MMPs are inhibited and regulated by the endogenous or natural tissue inhibitors of tissue inhibitors of MMP (TIMPs) and α2-macroglobulin [14].

Matrix Metalloproteinases (MMPs) play a crucial role in various tissue destructive inflammatory processes by degrading almost all peri-cellular and basement membrane components, and MMP-8 is known to be the major MMP in periodontitis [15–17]. For that reason MMP-8 may be a possible candidate as an adjunctive diagnostic biomarker in peri-implant diagnostics as well. PISF may offer similar possibilities in diagnosing the level of inflammation and markers of tissue destruction around implants as Gingival Crevicular Fluid (GCF) in natural teeth. PI PISF is known to contain higher MMP-8 levels and activity than GCF from chronic periodontitis sites with similar depth, and PI PISF also exhibits high activation of MMP-8 isoenzyme species (PMN and fibroblast-type) [18].

Hence, this study was conducted to a carry out the assessment of MMP levels in GCF and in peri implant sulcular fluid in healthy, chronic periodontitis and peri implantitis patients.

In this study, the mean level of MMP-8 in PISF was 36.98 ng/mL, whereas the mean MMP-8 level in GCF in subjects with healthy periodontium was 6.74 ng/mL.

Xu et al[18] compared collagenase activity and collagenolytic matrix metalloproteinase (MMP) levels in gingival crevicular fluid (GCF) and in peri-implant sulcular fluid (PISF) in gingivitis (G), chronic periodontitis (CP), and peri-implantitis (PI) human subjects. GCF and PISF were collected on filter paper strips, volume was determined, and samples were extracted in buffer containing general proteinase but not MMP inhibitors. Collagenase activity was measured using a DNP-synthetic octapeptide, and molecular and activation

forms of collagenase-2 by Western immunoblotting. GCF from CP and G sites exhibited elevated collagenase activity and flow, but collagenase concentrations expressed per microl were not significantly different between the healthy and G sites. Minimal fluid was obtained from healthy PISF, and collagenase concentration was the same or lower than in healthy GCF. Although PISF flow was 34% lower than GCF flow in CP subjects, collagenase concentration in CP and in PI sites was 78% and 971% greater, respectively, than in the appropriate healthy sites. Western immunoblot revealed MMP-8 in both PISF and GCF; fibroblast-type MMP-8 was not detected in healthy GCF and PISF. Immunoreactivity level and inactive and activated forms of PMN-type MMP-8 in GCF and PISF increased with the severity of periodontitis and peri-implantitis. Enhanced levels of fibroblast-type MMP-8 in active form were detected only in severe CP GCF and PI PISF. Peri-implantitis PISF contained higher collagenase-2 levels and activity than GCF from similar deep CP sites. GCF and PISF from severe CP and PI exhibited the highest activation of MMP-8 isoenzymes species (PMN and fibroblast-type).
Basegmez et al[19] collected PICF samples from 72 implants in 3-, 6-, 12-, and 18-months intervals by a masked examiner and reported that MMP-8 levels increased from the 3rd to the 18th-month samples. This increase was also correlated with plaque and gingival indices score increase. The study concluded that MMP-8 could be an early predictor for peri-implantitis.
Salvi et al[20] examined and compared implants to natural teeth for a 6-week follow-up. Their result showed that MMP-8 was higher around the implants than gingiva around the tooth. MMP-8 decreased after oral hygiene restarting, concluding MMP-8 reversibility. MMP-8 reached the peak around implants on day 21, the last day for plaque accumulation and refraining from oral hygiene.

CONCLUSION

Monitoring of MMP-8 levels in PISF may aid in early diagnosis of peri-implantitis, prior to clinical symptoms, which may enable prompt initiation of the necessary treatment.

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