Full-mouth profile of active MMP-8 in male periodontitis patients

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Background

Periodontitis is initiated by specific bacteria but it is predominantly the host response to this bacterial challenge that causes the destruction of the surrounding tissues. Active MMP-8 (aMMP-8, collagenase-2) derived from neutrophils is known to be the main host cell-originating collagenase leading to periodontal tissue destruction as a result of the degradation of gingival and periodontal ligament collagen. Active MMP-8 plays a key role in the pathogenesis of periodontitis. Analysis of single-site gingival crevicular fluid aMMP-8 values may enable the clinician to distinguish between healthy sites and those affected by gingivitis and periodontitis.
Up today, the diagnosis of periodontal disease is based on traditional clinical parameters and indices that reflect changes in the periodontal tissues that had already occurred. Variables like probing depths or bleeding on probing cannot predict future disease activity. Early diagnosis of tissue destruction is a challenge of modern periodontology. However, so far no parameters exist to predict the onset or progression of periodontitis.
Therefore, it was the aim of this investigation to obtain a full-mouth profile of active MMP-8 in untreated chronic periodontitis patients and to investigate the association between these biomarker values, pocket depths, bleeding, plaque and gingivitis.

Materials and Methods

Study design and patients

A mono-center, cross-sectional study was designed and approved by the Local Ethics Committee at the University of Technology, Dresden, Germany.

Ten adult male patients who had untreated chronic generalized periodontitis were included.

Exclusion criteria: Systemic diseases, antibiotic treatment less than 6 weeks before examination, less than 18 teeth, caries, orthodontic appliances.

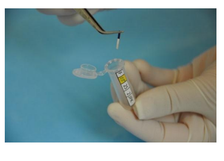
Clinical parameters

- Probing depths (PD)
- Bleeding on probing (BOP)
- Plaque index (PI; Silness & Löe 1964)
- Gingival index (GI; Löe 1967)

Probing depths and Bleeding on probing were evaluated at the same sites as aMMP-8 samples were taken.

Sulcus fluid samples

Sulcus fluid was gathered at four sites of every tooth (mesio-buccal, disto-buccal, mesio-oral, disto-oral). After cotton roll application, teeth were dried by a gentle blast of air without irritation of the gingiva and sulcus. Paper strips (PISF collection strips, dentognostics GmbH, Jena, Germany) were inserted 2 mm into the sulcus, remained there for 30 s, were removed and were stored in tubes at -20°C. In the laboratory, aMMP-8 was extracted, linked to antibodies, and dyed (ELISA). Active MMP-8 concentration was measured via optical density (Tecan-Sunrise-ELISA-Reader).



Statistics

Descriptive statistics; multiple and linear regression analyses for the prediction of PD or aMMP-8, respectively, were performed. The significance level was $p<0.05$.

Results

Table 1: Demographic data, aMMP-8 concentrations, and clinical variables of all patients. (PD: Probing depth, BOP: Bleeding on probing, PI: Plaque index, GI: Gingival index, SD: Standard deviation)

Patient number	Age (years)	Smoker	Number of sites	aMMP8 (mean±SD; ng/ml)	PD (mean±SD; mm)	BOP (% pos.)	PI (mean)	GI (mean)
1	57	no	100	19.11 ± 21.56	4.31 ± 1.33	52	1.37	1.24
2	52	yes	96	26.56 ± 38.47	4.70 ± 1.50	47	1.82	1.27
3	31	no	124	13.80 ± 11.69	4.04 ± 1.16	58	0.81	1.50
4	43	no	87	24.39 ± 29.87	5.01 ± 1.78	70	1.81	1.42
5	45	yes	116	29.03 ± 19.41	4.23 ± 1.32	89	1.80	1.25
6	45	no	100	11.97 ± 12.87	3.56 ± 1.09	42	0.90	1.25
7	59	no	76	13.83 ± 16.89	3.93 ± 1.78	42	0.99	1.32
8	67	no	108	9.69 ± 23.28	4.03 ± 1.06	46	1.18	1.27
9	38	no	124	18.34 ± 22.91	4.15 ± 1.18	85	1.35	1.37
10	34	yes	108	25.42 ± 19.76	4.00 ± 1.06	68	1.47	1.60

- Participants were on average 47.1 years old (range 31-67).
- Mean aMMP-8 concentrations per patient ranged from 9.69 to 29.03ng/ml. Only one patient had a concentration lower than 10 ng/ml and four patients had values higher than 24ng/ml.
- Three of the four patients who had the highest aMMP-8 concentrations were smokers.
- Standard deviations were high between patients and within the dentition of a patient.
- Mean pocket depths ranged between 3.56 and 5.01mm, mean BOP between 42% and 89%. Plaque index varied between 0.81 and 1.82, gingival index between 1.25 and 1.60.
- The multiple regression analysis did not reveal statistically significant predictions for neither PD nor aMMP-8. Comparing tables 3 and 4 concerning probing depths, it becomes obvious that a relation between probing depths and aMMP-8 does not exist (multiple regression analysis).
- aMMP-8 concentrations were significantly higher in sites with BOP than in sites without BOP.

Table 2: Multiple linear regression model for the prediction of PD on the basis of site level measurements (R^2 = 0.099, intraclass correlation = 0.050).

Variable	Regression coefficient	Standard error	P-value
Intercept	3.2863	0.1936	<.0001
Log aMMP-8	0.0989	0.0774	0.2014
PI	0.0942	0.1006	0.3491
GI	0.1149	0.1245	0.3559
BOP	0.6336	0.1231	<.0001

Table 3: Multiple linear regression model for the prediction of log (aMMP-8) on the basis of site level measurements (R^2 = 0.098, intraclass correlation = 0.176).

Variable	Regression coefficient	Standard error	P-value
Intercept	1.9023	0.2276	<.0001
PD	0.0453	0.0361	0.2093
PI	0.0168	0.0515	0.7449
GI	0.1017	0.0882	0.2488
BOP	0.3528	0.1340	0.0085

Table 4: Linear regression model for the prediction of log (aMMP-8) on the basis of PD (R^2 = 0.026, intraclass correlation = 0.196).

Variable	Regression coefficient	Standard error	P-value
Intercept	2.0719	0.2484	<.0001
PD	0.0937	0.0353	0.0080

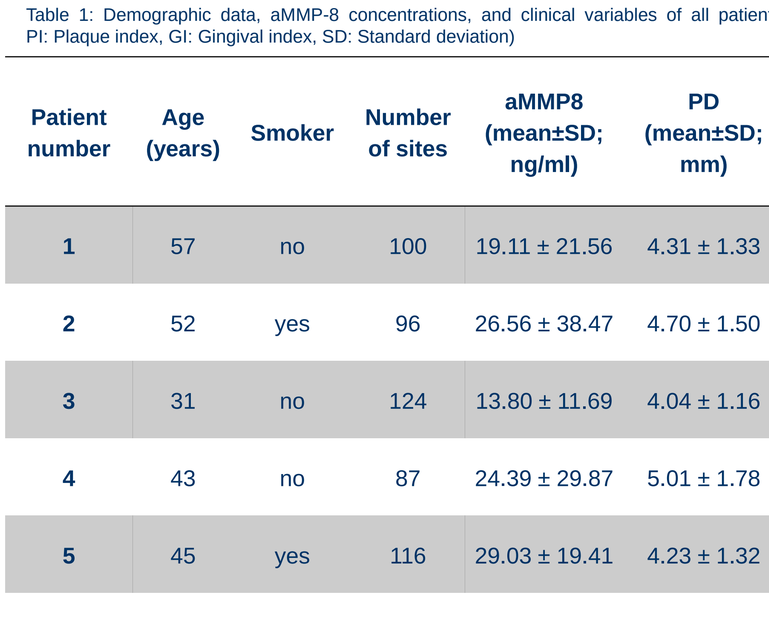


Figure 1: aMMP-8 concentrations (ng/ml) for each patient.

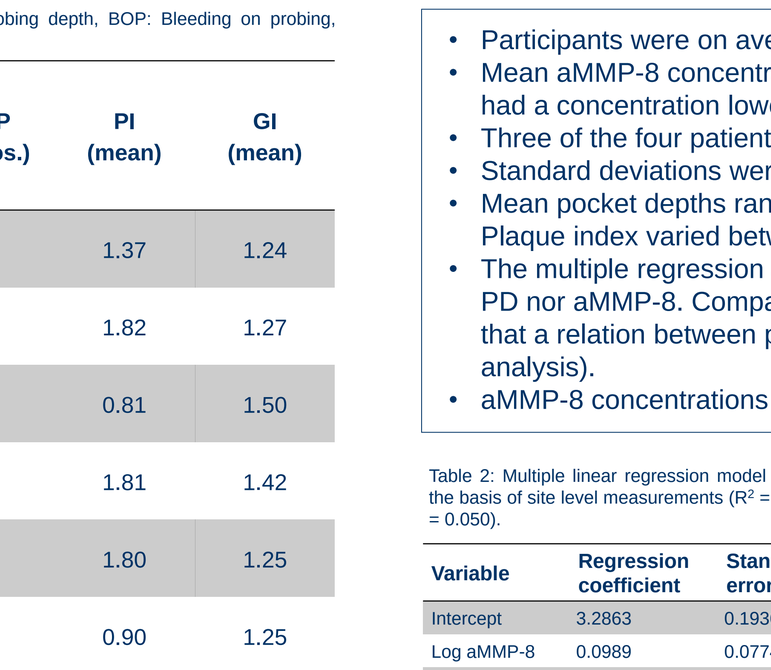


Figure 2: aMMP-8 concentrations (ng/ml) in relation to probing depths (PD; mm).

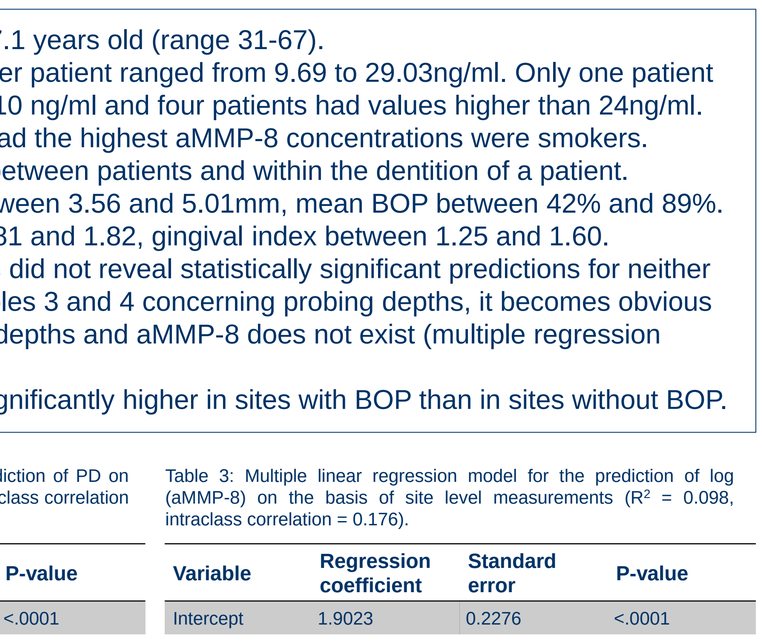


Figure 3: Observed log(aMMP-8) and PD (blue) values, predicted values for PD (red), and predicted value for log(aMMP-8) (green) for all patient findings.

Conclusions

Considerable intra-individual and inter-individual differences concerning aMMP-8 values existed in this sample of male chronic periodontitis patients. No relationship between aMMP-8 and PD was proven. Therefore, aMMP-8 cannot be applied as a prognostic factor for attachment loss in this patient sample.

This investigation was supported by the Association of German Dental Manufacturers VVDI e. V.