

ORIGINAL RESEARCH

Assessment of Pentraxin-3 levels during orthodontic tooth movement in patients undergoing fixed orthodontic treatment

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ABSTRACT:

Background: Tooth movement can be classified into physiological tooth movement and orthodontic tooth movement (OTM). The humoral arm of the innate immune response includes components of the complement cascade and soluble pattern recognition molecules (PRM), particularly collectins (surfactant protein-A, [SP-A], and SP-D), ficolins, (ficolin-1;-2;-3) and members of the pentraxin family (C-reactive protein [CRP], serum amyloid P component [SAP], and long pentraxin 3 [PTX3]). Hence; the present study was conducted for assessing the Pentraxin-3 levels during orthodontic tooth movement in patients undergoing fixed orthodontic treatment. **Materials & methods:** A total of 20 patients were enrolled in the present study which was scheduled to undergo fixed orthodontic treatment. Collection of GCF and estimation of PTX-3 levels was done at baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment, and 1 week after starting of fixed orthodontic treatment. Collection of GCF was done from the mesial side of maxillary canines. Isolation of the area was done with the help of cotton rolls. The GCF was collected with paper strips inserted into the crevice until mild resistance was felt and left there for 30 seconds. All the samples were sent to laboratory where an auto-analyser was used for evaluation of PTX-3 levels. **Results:** Mean PTX-3 levels at Baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment and 1 week after starting of fixed orthodontic treatment were found to be 0.95 ng/ml, 1.28 ng/ml, 2.45 ng/ml and 1.2 ng/ml respectively. While analysing statistically, it was observed that mean PTX-3 levels increased significantly till 24 hours after starting of the fixed orthodontic treatment to three times of its baseline values, and further declining significantly to its baseline range at 1 week after starting of fixed orthodontic treatment. **Conclusion:** Significant alteration of PTX-3 levels in the GCF does occur during the course of orthodontic treatment highlighting the role of inflammation in orthodontic tooth movement.

Key words: Pentraxin, Orthodontic treatment

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INTRODUCTION

Tooth movement can be classified into physiological tooth movement and orthodontic tooth movement (OTM). The application of orthodontic force can change the dental and paradental tissues. Previous studies have shown that several enzymes are expressed during these phases. These enzymes have been described as biomarkers during bone

remodeling. Biomarkers are biologically active substances which are classified as biomarkers of inflammation, bone resorption, cell necrosis, bone deposition, and mineralization.¹⁻³

The inflammatory response is mediated by a set of cells and soluble proteins belonging to the innate immune system. The humoral arm of the innate immune response includes components of the

complement cascade and soluble pattern recognition molecules (PRM), particularly collectins (surfactant protein-A, [SP-A], and SP-D), ficolins, (ficolin-1;-2;-3) and members of the pentraxin family (C-reactive protein [CRP], serum amyloid P component [SAP], and long pentraxin 3 [PTX3]).^{4,5}

As an exudate that reflects with fidelity the events in the periodontium, the gingival crevicular fluid (GCF) may be used to determine the levels of certain biomarkers. Expressions of biologically active substances in GCF in periodontal disease and its nonsurgical treatment, during initial phase of orthodontic tooth movement, or after various periodontal surgical techniques were highlighted so far.^{6, 7} Hence; the present study was conducted for assessing the Pentraxin-3 levels during orthodontic tooth movement in patients undergoing fixed orthodontic treatment.

MATERIALS & METHODS

The present study was conducted for assessing the Pentraxin-3 levels during orthodontic tooth movement in patients undergoing fixed orthodontic treatment. A total of 20 patients were enrolled in the present study which was scheduled to undergo fixed orthodontic treatment. Written consent was obtained from all the subjects after explaining in detail the entire research protocol. Collection of GCF and estimation of PTX-3 levels was done at baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment, and 1 week after starting of fixed orthodontic treatment. Collection of GCF was done from the mesial side of maxillary canines. Isolation of the area was done with the help of cotton

rolls. Supragingival plaque was removed with a curette without touching the marginal gingiva. Gentle drying of the site was done with an air syringe. The GCF was collected with paper strips inserted into the crevice until mild resistance was felt and left there for 30 seconds. All the samples were sent to laboratory where an auto-analyser was used for evaluation of PTX-3 levels. All the results were recorded in Microsoft excel sheet and one way ANOVA was used for evaluation of level of significance. P- value of less than 0.05 was taken as significant.

RESULTS

A total of 20 patients were enrolled in the present study which was scheduled to undergo fixed orthodontic treatment. Collection of GCF and estimation of PTX-3 levels was done at baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment, and 1 week after starting of fixed orthodontic treatment. Mean age of the patients was found to be 13.4 years. 55 percent of the patients were males while the remaining were females. Mean PTX-3 levels at Baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment and 1 week after starting of fixed orthodontic treatment were found to be 0.95 ng/ml, 1.28 ng/ml, 2.45 ng/ml and 1.2 ng/ml respectively. While analysing statistically, it was observed that mean PTX-3 levels increased significantly till 24 hours after starting of the fixed orthodontic treatment to three times of its baseline values, and further declining significantly to its baseline range at 1 week after starting of fixed orthodontic treatment.

Table 1: Demographic data

Parameter		Number of patients	Percentage of patients
Age group (years)	Less than 15	12	60
	More than 15	8	40
Gender	Males	11	55
	Females	9	45

Table 2: Comparison of PTX-3 levels

Time interval	Mean PTX-3 levels (ng/ml)	SD	p- value
Baseline	0.95	0.41	0.00 (Significant)
4 hours after starting of fixed orthodontic treatment	1.28	0.85	
24 hours after starting of fixed orthodontic treatment	2.45	0.98	
1 week after starting of fixed orthodontic treatment	1.29	0.49	

DISCUSSION

Pentraxin 3 (PTX3) is an acute phase protein that belongs to the pentraxin superfamily (with C reactive protein, CRP, and serum protein A, SAP) and is considered to be a marker of inflammation. PTX3 is a long pentraxin produced especially by fibroblasts and neutrophils. The levels of PTX3 in GCF in periodontal health and disease or during orthodontic treatment were estimated in previous studies. On the other hand, there are findings that link the PTX3 expression to fibroblast growth factor 2 (FGF2) suggesting the involvement of PTX3 in angiogenesis downregulating.⁸⁻¹⁰ Hence; the present study was conducted for assessing the Pentraxin-3 levels during orthodontic tooth movement in patients undergoing fixed orthodontic treatment.

A total of 20 patients were enrolled in the present study which was scheduled to undergo fixed orthodontic treatment. Collection of GCF and estimation of PTX-3 levels was done at baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment, and 1 week after starting of fixed orthodontic treatment. Mean age of the patients was found to be 13.4 years. 55 percent of the patients were males while the remaining were females. Mean PTX-3 levels at Baseline, 4 hours after starting of fixed orthodontic treatment, 24 hours after starting of fixed orthodontic treatment and 1 week after starting of fixed orthodontic treatment were found to be 0.95 ng/ml, 1.28 ng/ml, 2.45 ng/ml and 1.2 ng/ml respectively. Surlin P et al measured the levels of pentraxin-3 (PTX-3) in gingival crevicular fluid (GCF) in orthodontic young and adult patients in the first 2 weeks after the orthodontic appliance to determine whether those changes occur during orthodontic treatment and if those values could be the expression of an inflammatory state. GCF samples were collected with paper strips from 16 orthodontic young patients and 13 orthodontic adult patients from an upper canine requiring distalization as a test tooth. A contralateral canine was used as a control tooth. The absorbed volume was eluted in 100 µL phosphate-buffered saline (pH = 7.2). PTX-3 levels in GCF were determined using a commercial enzyme-linked immunosorbent assay kit, and the results were expressed in ng/mL. The results showed an increase of GCF levels of PTX-3 from 1 hour before the orthodontic appliance to a maximum at 24 hours, followed by a decrease in both groups of adult and young patients. The results suggested PTX-3 involvement in periodontal orthodontic remodeling and the aseptic inflammation induced by the orthodontic forces.¹¹

In the present study, while analysing statistically, it was observed that mean PTX-3 levels increased significantly till 24 hours after starting of the fixed orthodontic treatment to three times of its baseline values, and further declining significantly to its baseline range at 1 week after starting of fixed

orthodontic treatment. Rauten AM et al evaluated the involvement of Pentraxin 3 and Thrombospondin 1 in wound healing after periodontal surgery (gingivectomy) for gingival overgrowth during orthodontic treatment with or without magnification devices, by assessing their levels in GCF. From 19 patients with gingival overgrowth as a result of fixed orthodontic treatment, the overgrown gingiva was removed by gingivectomy, from one half of the mandibular arch without magnification and from the other under magnification. Pentraxin 3 and Thrombospondin 1 were determined from gingival crevicular fluid by ELISA tests. Statistically significant differences ($p < 0.05$) and correlations between levels of the two biomarkers were analyzed. Statistically significant differences were established between levels of the two biomarkers at different time points, with significant positive correlation at the point of 24 hours. The results seem to sustain the involvement of Pentraxin 3 and Thrombospondin 1 in the processes of inflammation and angiogenesis in wound healing of patients with postorthodontic gingivectomy. The dynamics of Pentraxin 3 and Thrombospondin 1 levels could suggest a reduced inflammation and a faster angiogenesis using microsurgery.¹² Pradeep AR et al assessed the levels of pentraxin-3 in gingival crevicular fluid and plasma in periodontal health and disease. Forty participants (20 males and 20 females; age range: 23 to 50 years) were involved in the study. Participants were divided into three groups based on gingival index, probing depth, and clinical attachment level: the healthy group (group 1; $n = 10$), gingivitis group (group 2; $n = 15$), and periodontitis group (group 3; $n = 15$). Gingival crevicular fluid (GCF) and plasma samples collected from each subject were quantified for PTX3 levels using an enzyme-linked immunosorbent assay. In tandem with the disease progression from healthy to gingivitis to periodontitis, the mean PTX3 concentrations increased in GCF and plasma. However, GCF values were higher than plasma values. It was found that PTX3 concentration was highest in group 3 and lowest in group 1. PTX3 concentrations also correlated positively with periodontal parameters. GCF and plasma PTX3 concentrations correlated positively in all groups. The differences in plasma PTX3 levels were not found to be statistically significant.¹³

CONCLUSION

From the above results, the authors concluded that significant alteration of PTX-3 levels in the GCF do occur during the course of orthodontic treatment highlighting the role of inflammation in orthodontic tooth movement. However; further studies are recommended.

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