Comparative Evaluation of IL-1β levels in Gingival Crevicular Fluid (GCF) of the Teeth Supporting Porcelain Fused to Metal Crowns (P.F.M)

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Abstract

Background and Objective: Using fused to metal porcelain as crowns is the most common methods of replacing missing teeth. IL-1-beta plays a key role in immunity and inflammation. Gingival crevicular fluid (GCF) reflecting the periodontal inflammation was sampled in the same area. This study aimed to compare the amount of IL-1β in the GCF of porcelain-fused to metal crowns with that of healthy teeth.

Method: This case-control study was performed on 16 people with porcelain-fused to metal crowns with clinically acceptable standards. The history of non-systemic disease, not smoking and taking any regular medications up to 6 past months was taken. Healthy teeth corresponding to veneered teeth in the opposite side of the jaw were selected as control group. After the initial sampling the teeth received a phase of a non-surgical dental treatment, and the sampling was repeated at 1 and 3 months after the initial sampling. After collecting data with SPSS23 statistical software the data was entered into computer. To compare the concentrations of IL-1β in the two groups Paired t-test was used. Results: The concentration of IL-1β at all the three intervals of testing in teeth with porcelain fused to metal crowns was higher than of it in the control group (P< 0.001). Furthermore, the concentration of IL-1β was decreased in both groups during the whole time. (P<0.001 & P<0.003).

Conclusion: The concentration of IL-1β in GCF of teeth with porcelain-fused to metal crowns with clinically acceptable standards is higher than of that in healthy teeth. Porcelain-fused to metal crowns are involved in the production of IL-1β.

Keywords: IL-1β, porcelain-fused to metal crowns, GCF, PFM.

Introduction and Problem Statement

The use of porcelain-fused to metal crowns is the most common method for replacing the missing teeth. Today using porcelain-fused to metal crowns, it is possible to rebuilt and replace the large areas of missing teeth or crowns (1). All prosthesis and reconstructive treatments need healthy periodontal tissues as a prerequisite for successful results (2).

It seems that the basic mechanism of this destructive process is by the direct effects of bacterial products of dental plaque and bacterial induction of the host immune and inflammatory reactions (3). Periodontal disease is typically detected and recorded based on clinical factors, including Clinical Attachment Loss (CAL), Bleeding on Probing (BOP), Probing Depth (PD) and Bone loss that can be seen in X-rays (4). Evaluating the host response is among the other advanced methods for detecting the periodontal disease, which includes the investigation of specific or non-specific
mediators using biochemical or immunological methods, and it is known as a part of individual response to periodontal infections. Potential sample sources in these studies are saliva, GCF (Gingival Crevicular Fluid) and serum (5). Increased concentrations of cytokines such as IL-1, -2, -4, -6, -8 and TNF were reported in GCF of people with periodontal disease (6-12). IL-1β is a pro-inflammatory cytokine, which stimulates the production of molecules and mediators that facilitate and accelerate the inflammatory response of periodontal disease (4). This cytokine is associated with tissue destruction and its biological effects include stimulation of T-lymphocytes and the production of cytokines, proliferation of B-lymphocytes and antibodies, the proliferation of fibroblasts, the stimulation of prostaglandins (PG-E2 E2) released from monocytes and fibroblasts, release of metalloproteinase matrix and destruction of extracellular matrix proteins (13, 14).

IL-1-beta stimulates the production of osteoclasts and bone resorption, as well. Furthermore, it influences on neutrophil chemotaxis and activity and function of endothelial cells (15).

IL-16 plays a key role in immunity and inflammation, it is mostly produced by monocytes, macrophages and neutrophils and other cell types such as fibroblasts, keratinocytes, epithelial cells, B cells and osteocytes, it increases ICAM expression on the surface of epithelial cells and stimulates the secretion of CXCL8 chemokines, which stimulates and facilitates the infiltration of neutrophils in the affected tissues. Moreover this molecule stimulates IL-6 secretion from macrophages to activate B lymphocytes. IL-1-beta increases IL-8 secretion, resulting in increasing neutrophil chemotaxis. Furthermore, IL-18 plays a role in increasing the stimulation of T lymphocytes by antigen. The concentration of IL-18 is increased in GCF of areas with gingivitis and periodontitis. Tissue levels of IL-1-8are also associated with the severity of periodontal disease (16).

In some works, it has been observed that the IL-1-8has direct and significant relationship with periodontal disease (4, 17).

The sampling of GCF was conducted with more given time compared to saliva samples reflecting periodontal inflammation in the same area (15).

Answering to this question that whether, cast crown effects on periodontal status or not, is the subject of various studies in dentistry over the years (2, 18, 19).

Existence of crowns on teeth, regardless of other factors associated with its quality, is effective significantly in the incidence inflammations in the gum and increasing the sulcus depth of relative teeth. (20)

According to the standards of care provided by Amsterdam, all dentists should consider the materials that maintain periodontal health, to reduce the risk of periodontal and systemic diseases (21).

Considering the prevalence of PFM treatment and critical nature of periodontal health tooth in this regard, in order to have a successful treatment and to evaluate the relationship between the IL-1β concentration with PFM treatment as an indicator of periodontal disease, we decided to investigate IL-1-8concentration in the GCF of treated teeth with PFM in this study. In a study conducted by Yuan Tangxiaet.al, in 2011, in China on three types of PFM crowns made by chrome-cobalt, nickel-chrome and gold-platinum alloys, the concentration of IL-1-8 was significantly different at 6 and 12 months after placing chromium-cobalt and nickel-chrome crowns compared to the pre-treatment state. No significant difference was observed in gold-platinum crowns. Based on the results of their study they concluded that non-noble metals have detrimental effect on periodontal tissue (22).

Based on a study conducted by Julide OZEN, in Turkey, in 2000, the concentration of IL-1-8was significantly increased 4 months after placing Cr Ni MO crowns. However, concentration of IL-1-8 in two gold-Platinum and all-ceramic crowns was not significantly different. They concluded that base alloys cause to more gingival inflammation compared to high noble alloys and all ceramics (23).

In the study of EO Erdemiret al. in Turkey, in 2009, which was performed to examine the periodontal status and the concentration
of 6 and 8 interleukins, there was significant difference between the concentration of IL-6 and IL-8, 1 and 3 months after treatment with crowns by scaling and root planning SRP. They concluded that non-surgical treatment reduces the concentrations of IL-6 and IL-8 in both healthy teeth and teeth with PFM crowns; however, due to a greater extent of Plaque index (PI), Probing depth (PD) and Gingival index (GI) in teeth with PFM, a preventive treatment is required for these teeth (24).

In the study of LüHui et al. which was conducted in Shenyang hospital, in China, in 2010 on 254 teeth in 78 patients, bleeding index (BI) and discoloration of gum was significantly different in teeth treated with nickel-chromium crowns a year after treatment, however, the discoloration and BI in teeth treated with Noble metals crowns were not increased significantly. They concluded that the galvanized coating shave the least harmful effects to the health of periodontal tissue and Ni-Cr coatings and crowns containing precious metals have the most destructive effects (25).

Fanq et. al. performed a study in Shang Hang in, 2016, on 52 people, and they found that, the concentration of IL-23 in GCF of teeth treated with porcelain- fused to metal and the periodontal destruction was much higher than the healthy teeth. They concluded that porcelain- fused to metal crowns can have a role in periodontal destruction and the production of IL-23 (26).

In the study of JIANG Yong et. al which was conducted at Peking University in China, in 2004, significant differences were found between the periodontal index of teeth treated with nickel-chrome coatings and healthy teeth. They concluded that even the nickel-chrome crowns with acceptable clinical features, have destructive effects on the health of the gums (27).

Zhang et. al in a study that was conducted in 2011, evaluated 21 patients with Au-Pt coating. All coatings were acceptable clinically. The gingival bleeding, probing depth and volume of GCF in the teeth treated, porcelain- fused to metal crowns were higher than healthy teeth. They concluded that Au-Pt coatings have detrimental effect on the health of teeth and gums treated with such coatings (28).

Method

The sample size and its calculating method were considered 16 for this study, according to similar studies, and given the financial constraints (29, 30). Simple sampling method was available.

Methods and tools for collecting information were based on the information forms and the IL-1-β concentrations recorded for each patient.

The method of information analysis: To describe the data, the mean and standard deviation were used. Paired t-test pair was used to compare the concentrations of IL-18 in the two groups. Furthermore, for the analysis of IL-18 during different intervals in each group, the ANOVA test was used for duplicate data.

This study is a case-control work, in which the patients who refer to Zahedan Dental School with the following features are examined. The patients do not have any systemic and periodontal diseases and they have porcelain-fused to metal crowns on one side of the arch based on the following criteria: strict margin compliance, lack of gap, lack of overhang, lack of harmful margin, precise polishing of metal in the edge of margin, precise glazing or polishing of porcelain, exact contouring of crowns, proper occlusion of crowns, correct emergence profile of crowns, and the dental arch similar to the same tooth, healthy and non-covered teeth on the other side.

Exclusion Criteria

- The use of tobacco products
- A history of any drugs taking in the past six months
- Pregnancy and lactation

In this study, the patients were examined who referred to the Dentistry School of Zahedan, for placing porcelain fused to metal crowns. The patients were selected whose crowns had the criteria of a standard crown which were mentioned in the inclusion and exclusion criteria, and had no systematic disease, based on the measuring of the probing depth by Williams probing and clinical attachment level and clinical signs, the absence of periodontal disease was diagnosed in the patients.
Standard crowns were specified by the student and approved by the supervisor. The absence of systemic disease was determined by students based on the patient's questions and answers and the absence of periodontal disease was determined by the student and approved by the professor. People with no systemic and periodontitis diseases and with standard crowns and corresponding healthy teeth in opposite arc were enrolled. GCF sampling was performed by students. To avoid changing the composition of GCF, the initial sampling was performed before first phase of non-surgical treatment. In a way that, at first to assess the concentration of IL-1β in GCF, the surface and around the tooth were cleaned with cotton rolls and then were isolated.

The concentration of IL-1β was decreased significantly just in time 2 (P< 0.001).

The concentration of IL-1β in control group was decreased significantly just in time 2 (P< 0.001). The concentration of IL-1β in experimental group was increased in time 2 (P< 0.001).

Evaluating the IL-1β concentration of GCF in both control and experimental groups shows that the concentration of IL-1β in three intervals was higher in group of teeth with PEM crowns (P< 0.001).

Initially inserting the 4-absorbing paper (paper point No. 25) in pocket depth for 30 seconds, 4 points (buccal, mesial, distal and lingual), the GCF of healthy teeth and dental crowns was collected in opposite arc of the same jaw, and was placed within the sterile tube containing 300 µl of PBS (Phosphate Buffered Saline), it was stored at -70 ° C, until the ELISA test performing. After collecting all samples from patients, the concentration of IL-1β in samples was measured by ELISA test. Then health training and SRP were performed for patients of non-surgical first phase therapy. Re-sampling was performed 1 and 3 months after non-surgical first phase treatment of patients and the concentration of IL-1β was measured.

**Findings**

Table 1: Comparing the concentration of IL-1β of GCF in three different intervals between studied groups

<table>
<thead>
<tr>
<th>Concentration of IL-1β</th>
<th>Interval 1 (Mean ±SD)</th>
<th>Interval 2 (Mean ±SD)</th>
<th>Interval 3 (Mean ±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group(plated tooth) PMF</td>
<td>89.0 ± 9.0</td>
<td>77.1 ± 7.0</td>
<td>82.0 ± 8.1</td>
</tr>
<tr>
<td>The control group (healthy tooth)</td>
<td>75.0 ± 8.4</td>
<td>69.1 ± 8.2</td>
<td>70 ± 8.0</td>
</tr>
<tr>
<td>P value</td>
<td>P&lt;0.001</td>
<td>P&lt;0.001</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>

Porcelain can be matched to the color of patients’ teeth, as well. IL-1β is a pro-inflammatory cytokine that stimulates the production of molecules and mediators which facilitate and accelerate the inflammatory response of periodontal disease (4). These cytokines are associated with tissue destruction, some of their biological effects are including, stimulating T lymphocytes and cytokine production, proliferation of B lymphocytes and antibodies, proliferation of fibroblasts, stimulating prostaglandin (PG-E2 E2) released from monocytes and fibroblasts and the release of metalloproteinase matrix and degradation of extracellular matrix proteins (13, 14).

GCF is an important physiological fluid which has high amounts of profile that reflect the systemic health changes. Given that collecting of GCF is not relatively easy and it is not accessible easily, and due to the lack of information and existing disparities in the field of research topics, the aim of this study was to evaluate the concentration of IL-1β in three different intervals between studied groups.
16 as an indicator of inflammation in the GCF of patients with PFM.

In this study, 16 patients with PFM veneer were enrolled to evaluate the concentration of IL-18 in people with PFM. The teeth with veneer in each person were evaluated as groups, besides healthy and corresponding teeth of the same person were studied as the control group.

The results showed that the concentration of IL-16 in the teeth with PFM veneer is higher than the healthy teeth (P <0.001).

Yuan Tangxiaiet.al showed that the concentration of IL-16 is significantly different at 6 and 12 months after placing chromium-cobalt and nickel-chrome crowns compared to the pre-treatment state (22). The duration of their study was extended compared to our study, however, the results of their work indicate high inflammations in teeth with PFM, similar to our study.

According to the study of Julide OZEN et al. the concentration of IL-16, was significantly increased 4 months after leaving Cr Ni Mo veneer (23), which is consistent with this current work. The examined alloy in their study was different, however, similar obtained results may due to the use of non-noble alloys in both works.

It should be noted that in the two pre-mentioned studies, the teeth were examined before and after inserting veneers, however, in this current work, the teeth were investigated after inserting the veneers, while similar results have been obtained.

Less similar articles exist in this field, however, the studies related to the inflammatory cytokines or other inflammatory indices are discussed in the following.

In the study of EO Erdemiret.al, the concentration of IL-6 and IL-8, was not significantly different 1 and 3 months after coating treatment with SRP. However, the rate of PI, PD and GI was higher in teeth with PFM compared to the healthy teeth (24). In this study, similar to the current work, SRP treatment was performed to create equal conditions and to eliminate other pathogens. Their study was conducted with the same periods and intervals as those in our work and no significant changes were observed in the IL concentration in their work. However, contract results may due to differences in the examined IL type. In addition, although they did not find significant differences in concentration of IL-6 and IL-8, periodontal defects were observed.

Fanq et.al observed the concentration of IL-23 and further more periodontal destruction in treated teeth with porcelain fused to metal crowns compared to healthy teeth (26), which is consistent with current work. In their study evaluating the IL concentration was performed in single step, and healthy people were compared with those with periodontitis and gingivitis. However, in this current work all patients had no periodontitis.

In the study of LüHuiet.al, discoloration of gum and increased bleeding index (BI) was considerable in nickel-chromium veneered teeth treated after one year. In teeth treated with crowns made with noble metals, no considerable discoloration and increase in BI were found (25), this result indicates the inflammation of the teeth treated with PFM, which is consistent with the result of our study.

Yong et.al also found a significant difference between periodontal index of treated teeth coated with nickel-chrome and healthy teeth (27), which is similar to our findings. In addition, they evaluated the crowns with acceptable features, which is not inconsistent with our study.

In the study of, Zhang et.al which was conducted on clinically acceptable crowns, the gingival bleeding, probing depth and volume of GCF in the teeth treated with porcelain fused to metal veneer, were higher compared to healthy teeth (28), which represents more inflammation of teeth with PFM, this result is similar to our results, as well. In their study all the examined veneers were based on acceptable standard, similar to ours.

**Conclusion**

The concentration of IL-18 in GCF of teeth with PFM veneers with clinically acceptable standards is higher compared to healthy teeth. PFM crowns are involved in producing IL-18.

**Suggestions**

Further studies are recommended to determine the effects of PFM crowns on the health of the gums and periodontal tissue.

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