



## Effect of two kinds of porcelain crown on AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA levels in gingival crevicular fluid

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### ABSTRACT

**Objective:** To investigate the effect of two kinds of porcelain crown on AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA levels in gingival crevicular fluid. **Methods:** A total of 80 patients with dental porcelain crowns at front teeth during February 2013 to February 2016 were randomly divided into cobalt-chromium alloy PFM group ( $n=40$ ) and gold alloy PFM group ( $n=40$ ). After 6 months, the amount of gingival crevicular fluid, GI, PD, AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA levels in gingival crevicular fluid were recorded and analyzed. **Results:** There were no differences in amount of gingival crevicular fluid, GI and PD before treatment of the two groups ( $P>0.05$ ). After treatment, the amount of gingival crevicular fluid, GI and PD of the two groups were significantly higher than before treatment ( $P<0.05$ ), but the amount of gingival crevicular fluid, GI and PD of the gold alloy PFM group were significantly lower than that of cobalt-chromium alloy PFM group ( $P<0.05$ ). There were no differences of the AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA levels in gingival crevicular fluid before treatment of the two groups ( $P>0.05$ ). After treatment, the AST, ALP, TNF- $\alpha$ , IL-8 and MDA levels in gingival crevicular fluid of the two groups were significantly higher than before treatment ( $P<0.05$ ), but that of the gold alloy PFM group were significantly lower than cobalt-chromium alloy PFM group ( $P<0.05$ ). After treatment, the GP-x level in gingival crevicular fluid of the two groups were significantly lower than before treatment ( $P<0.05$ ), but that of the gold alloy PFM group were significantly higher than cobalt-chromium alloy PFM group ( $P<0.05$ ). **Conclusions:** Gold alloy PFM can significantly reduce the AST, ALP, TNF- $\alpha$ , IL-8 and MDA levels in gingival crevicular fluid, improve the GP-x level in gingival crevicular fluid, shows better biocompatibility and clinical outcomes than cobalt-chromium alloy PFM.

## 1. Introduction

Porcelain-fused-to-metal (PFM) is the main method for the repair of dentition defect and defect in the Department of Stomatology at present, which accounts for more than 60% of the crown and bridge repair. It has the advantages of vivid color, beautiful appearance, small volume, high strength, comfortable wearing, good recovery of chewing function, and low irritation to the gums, so It is welcomed

by doctors and patients[1,2]. It was found that the metal ions were separated from the metal ions by the corrosion of the metal, which directly caused the inflammatory reaction in the periodontal tissues. Cobalt chromium alloy and gold alloy are two kinds of metal materials that are commonly used, and their metal composition is different, so the damage caused by periodontal tissue and inflammatory reaction may also be different[4]. When the periodontal tissues are injured, the amount and the content of the components of crevicular fluid gingival (GCF) will become abnormal, such as the level of enzymes, inflammatory factors, oxidative stress markers, etc. will change[5,6]. This study was to investigate the effects of two kinds of porcelain fused to cobalt chromium alloy and gold alloy on the level of aspartate transaminase (AST), alkaline phosphatase (ALP), tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-8 (IL-8), glutathione peroxide (GP-x) and malondialdehyde (MDA) in

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gingival crevicular fluid. The results are as follows.

## 2. Materials and methods

### 2.1. General information

A total of 80 patients with dental porcelain crowns at front teeth during February 2013 to February 2016 were chosen as subjects. Case inclusion criteria were as follows[7]: (1) Patients with complete dentition, no loosening, and normal occlusion; (2) Patients that need to repair lesions of maxillary anterior teeth; (3) Patients not treated with periodontal therapy. Case exclusion criteria were as follows: (1) Patients with acute and chronic disease; (2) Patients with mental illness; (3) Women in pregnancy or lactation; (4) Patients who used antibiotics in the past 3 months. All patients were randomly divided into cobalt-chromium alloy PFM group and gold alloy PFM group, 40 cases each. There were 23 males and 17 females in the cobalt-chromium alloy PFM group, they were aged from 19 to 50 years old, mean age (35.19±14.55) years old; There were 22 males and 18 females in the gold alloy PFM group, they were aged from 20 to 49 years old, mean age (34.35±10.04) years old; .There were no significant differences in gender, age and other general data between the two groups ( $P>0.05$ ). All patients were informed consent and volunteered to join the study, and approved by the hospital ethics committee.

### 2.2. Experimental method

#### 2.2.1. Crown restoration method

Two groups of patients with maxillary lesions in the anterior teeth were made of cobalt chromium alloy (Materials purchased from the German Bego company, containing cobalt 60.2%, chromium 25%, gallium 2.9%, molybdenum 4.8%, other 7.1%) and gold alloy porcelain crown (Materials purchased from the United States there are research billion gold, gold 86.2%, zinc 2.3%, manganese 2.3%, thallium 11.5%). Specific requirements were as follows: Preparation of 1.2-1.5 mm on the lip side, the base of the cut end of the tooth preparation 2 mm, the lingual preparation 1.2 mm. The right angle shoulder, width 0.8-1.0 mm, and the adjacent surface polymerization degree was 4 degrees, and further to the bottom of the 0.5 mm. After 5 days without discomfort, two groups of patients were treated with glass ionomer cement for cement, which was a permanent adhesive.

#### 2.2.2. Acquisition of GCF

A sterile cotton swab was used to remove received supragingival plaque and large plaque, then the I Whatman number was inserted into the corresponding site of the tested teeth, until there was a slight resistance. It was kept 60 s then taken out, placed in EP tube, immediately weighed, sealed and preserved. The quality difference between the EP tube was the quality of the GCF tube, then divided by 1 mg/ $\mu$ L, got the volume of GCF.

### 2.3. Detection index

The amount of Gingival index (GI), Probing depth (PD) and GCF and the level of AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA in GCF were detected before and after 6 months of PFM repair in the two groups.

The GI classification was as follows: Gingival health for 0 point; Mild inflammation of gingiva for 1 point; Severe inflammation of the gums for 3 points; The higher GI score indicates more severe gingivitis. PD represents the depth of the gingival margin to the periodontal pocket or the bottom of the gingival sulcus. Detection of AST and ALP levels in GCF were used Beckman Kurt AU5800 automatic biochemical analyzer; Double antibody sandwich enzyme linked immunosorbent assay was used to detect the levels of TNF- $\alpha$ , IL-8, GP-x and MDA, and the ELISA test kit was purchased from Wuhan Gene Technology Co., Ltd, all operations were carried out strictly in accordance with the instructions of the kit.

### 2.4. Statistical method

SPSS19.0 software package was carried out, mean  $\pm$  standard deviation represented measurement data,  $t$  test was used to compare between groups of measurement data and count data, with  $P<0.05$  as a statistically significant difference.

## 3. Results

### 3.1. Comparison of GCF, GI and PD between the two groups before and after repair

Before repair, the amount of GCF, GI and PD in cobalt-chromium alloy PFM group were (0.50±0.11)  $\mu$ L, (0.00±0.00) and (1.24±0.10) mm, and in gold alloy group, the amount were (0.51±0.13)  $\mu$ L, (0.00±0.00) and (1.26±0.11) mm, there was no significant difference in the amount of GCF, GI and PD between the two groups ( $P>0.05$ ); After repair, the amount of GCF, GI and PD in cobalt-chromium alloy PFM group were (0.83±0.16)  $\mu$ L, (1.03±0.21) and (2.11±0.14) mm, and in gold alloy group, the amount were (0.66±0.14)  $\mu$ L, (0.24±0.05) and (1.84±0.12) mm. The amount of GCF, GI and PD in the two groups were significantly higher than those before repair, and the amount of GCF, GI and PD in gold alloy group were significantly lower than that of cobalt-chromium alloy PFM group, and the difference was statistically significant ( $P<0.05$ ).

### 3.2. Comparison of AST, ALP and TNF- $\alpha$ levels in GCF between two groups before and after repair

Before repair, there was no significant difference in the levels of AST, ALP and TNF- $\alpha$  between the two groups ( $P>0.05$ ); After repair, the levels of AST, ALP and TNF- $\alpha$  in the two groups were

significantly higher than those before repair, and the levels of AST, ALP and TNF- $\alpha$  in gold alloy group were significantly lower than that of cobalt-chromium alloy PFM group ( $P<0.05$ ) (Table 1).

### 3.3. Comparison of IL-8, GP-x and MDA levels in GCF between the two groups before and after repair

The levels of IL-8, GP-x and MDA in two groups before repair were compared, and the differences were not statistically significant ( $P>0.05$ ); After repair, the levels of IL-8 and MDA in the two groups were significantly higher than those before repair, while IL-8 and MDA levels in gold alloy group were significantly lower than that in cobalt-chromium alloy PFM group; The levels of GP-x in two groups were significantly lower than that before repair, while the GP-x level of GCF in the gold alloy group was significantly higher than that of cobalt-chromium alloy PFM group ( $P<0.05$ ) (Table 2).

## 4. Discussion

PFM is a kind of metal porcelain fused to metal crown on the metal substrate, which is the most important method of dental restoration[8]. With the development of medical technology, the research of PFM has become more and more deeply. At present, it is found that there are some effects on the periodontal tissues of patients after PFM repair, which can cause periodontal injury and inflammatory reaction[9]. Oral environment is very complex, the daily circumstances of the mouth in the pH, temperature, humidity constantly change, the combined effects of various factors can lead to the occurrence of chemical reactions in the molten metal materials, which releases the metal ions, thus causing damage to the periodontal tissue, and even endanger the health of patients[10]. GI and PD are used to describe the change of periodontal tissue[11]. GCF is widely used in periodontal disease, and it has been used in the evaluation of the inflammatory response in the study of oral rehabilitation, and GCF secretion is an important indicator of

periodontal inflammation[12]. There are a large number of enzymes in GCF, the changes of AST and ALP contents were closely related to the activity of periodontitis[13]. In addition, a large number of inflammatory cytokines and oxidative stress markers are released into the GCF, which can be used for the diagnosis of periodontal lesions[14]. This study was to investigate the effects of two kinds of porcelain fused to cobalt chromium alloy and gold alloy on the level of AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA in gingival crevicular fluid, so as to provide a certain clinical basis for the use of a reasonable fusion of metal materials for the repair of PFM.

The results of this study showed that there was no significant difference in the amount of GCF, GI and PD between the two groups before repair ( $P>0.05$ ); After repair, The amount of GCF, GI and PD in the two groups were significantly higher than those before repair, and the amount of GCF, GI and PD in gold alloy group were significantly lower than that of cobalt-chromium alloy PFM group, and the difference was statistically significant ( $P<0.05$ ). This indicated that the damage to the periodontal tissue of the gold alloy was lighter than that of the cobalt-chromium porcelain fused to metal crown. The increase of GCF secretion is the main performance of gingival inflammation, and its secretion increased with the increase of the degree of inflammation[15]. The higher GI score indicates more severe gingivitis. PD indicates the depth of the gingival margin to the periodontal pocket or the bottom of the gingival sulcus, the higher the value, the greater the chance of PFM repair after periodontal reaction. In addition, the results of this study showed that there was no significant difference in the levels of AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA between the two groups ( $P>0.05$ ); After repair, the levels of AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA in the two groups were significantly higher than those before repair, and the levels of AST, ALP, TNF- $\alpha$ , IL-8, GP-x and MDA in gold alloy group were significantly lower than that of cobalt-chromium alloy PFM group, and the difference was statistically significant ( $P<0.05$ ). The levels of GP-x in two groups were significantly lower than that before repair, while the GP-x level of GCF in the gold alloy group was significantly higher than that of cobalt-chromium alloy PFM group, and the difference was statistically significant ( $P<0.05$ ).

**Table 1**

Comparison of AST, ALP and TNF- levels in GCF between two groups before and after repair.

Groups	n		AST ( $\mu$ IU)	ALP ( $\mu$ IU)	TNF- $\alpha$ (ng/mL)
Cobalt-chromium alloy PFM group	40	Before repair	354.37 $\pm$ 60.14	48.37 $\pm$ 14.60	0.67 $\pm$ 0.05
		After repair	648.86 $\pm$ 91.07 <sup>*</sup>	96.84 $\pm$ 16.33 <sup>*</sup>	1.05 $\pm$ 0.09 <sup>*</sup>
Gold alloy group	40	Before repair	359.82 $\pm$ 63.55	49.41 $\pm$ 15.29	0.69 $\pm$ 0.06
		After repair	435.42 $\pm$ 80.11 <sup>#</sup>	70.22 $\pm$ 15.87 <sup>#</sup>	0.82 $\pm$ 0.08 <sup>#</sup>

Note: compared with before repair, <sup>\*</sup> $P<0.05$ ; compared with cobalt-chromium alloy PFM group, <sup>#</sup> $P<0.05$ .

**Table 2**

Comparison of IL-8, GP-x and MDA levels in GCF between the two groups before and after repair.

Groups	n		IL-8 (pg/mL)	GP-x (ng/mL)	MDA (ng/mL)
Cobalt-chromium alloy PFM group	40	Before repair	304.12 $\pm$ 48.36	184.36 $\pm$ 30.15	5.64 $\pm$ 0.47
		After repair	579.88 $\pm$ 93.54 <sup>*</sup>	103.47 $\pm$ 19.54 <sup>*</sup>	7.71 $\pm$ 0.64 <sup>*</sup>
Gold alloy group	40	Before repair	309.53 $\pm$ 51.72	185.28 $\pm$ 33.70	5.69 $\pm$ 0.52
		After repair	431.18 $\pm$ 70.54 <sup>#</sup>	146.19 $\pm$ 20.01 <sup>#</sup>	6.45 $\pm$ 0.59 <sup>#</sup>

Note: compared with before repair, <sup>\*</sup> $P<0.05$ ; compared with cobalt-chromium alloy PFM group, <sup>#</sup> $P<0.05$ .

This suggested that the gold alloy was smaller than that of cobalt chromium alloy porcelain fused to metal crown, and has a good biocompatibility. This may be due to the cobalt chromium alloy can form a dense oxide film by Cr-O and Cr-OH, but the metal ions can be corroded in the complex environment of the oral cavity, which will produce some damage to the periodontal tissues, while the metal materials used in gold alloys are very stable, with a strong resistance to corrosion and oxidation resistance, not easy to precipitate metal ions, so that the impact on the periodontal tissue is small[17]. AST is a soluble cytosolic enzyme, which is normally found in the cytoplasm of cells. When the tissue is damaged, a large number of cells are in the extracellular environment. ALP is a hydrolytic enzyme, which is more than 20 times the normal level in the gingival sulcus fluid of inflammatory teeth[18,19]. AST and ALP can sensitively reflect the damage degree of periodontal tissue. TNF- $\alpha$  and IL-8 are important factors in the two groups, which have a high level of inflammation in the tissue[20]. GP-x is a kind of antioxidant enzyme, which can block the damage of oxygen free radicals to the body. It was found that GP-x activity was negatively correlated with the depth of probing and the loss of attachment, and the GP-x activity in gingival sulcus fluid was increased after periodontal treatment, and GP-x can be used to judge the degree of periodontal inflammation[21]. Some studies found that MDA levels in gingival fluid of patients with periodontitis were significantly higher than those in healthy subjects. MDA is a product of lipid peroxidation, can indirectly reflect the degree of cell injury[22].

To sum up, compared with cobalt chromium alloy, the gold alloy can significantly lower the AST, ALP, TNF- $\alpha$ , IL-8 and MDA levels in the gingival sulcus fluid, improve the level of GP-x in gingival sulcus fluid. The irritation of the gold alloy on the gums was light, with good biocompatibility, and the clinical effect was good.

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