

Estimation of Concentration of Nickel and Chromium in the GCF of Patients with Fixed Orthodontic Appliance

Daya Shankar^{1*} Ritika Agarwal² Shivendra Choudhary³

¹Ex Assistant Professor, Department of Dentistry, Patna Medical College and hospital, Patna, Bihar, India.

²Senior Resident, Department of Dentistry, Patna Medical College and hospital, Patna, Bihar, India.

³Associate Professor and Head, Department of Dentistry, Patna Medical College and hospital, Patna, Bihar, India.

ABSTRACT

Background: Release of nickel and chromium ions into saliva can occur due to the corrosion of orthodontic alloys which may influence on systemic levels.³ Exposure biomarkers are used to measure the systemic effects. Medium for systemic exposure with reasonable sensitivity might be gingival crevicular fluid (GCF).

Materials and Methods: The PerioPaper strips were gently placed in the sulcus for 60 seconds. If bleeding was observed at the site of examination, that site was discarded and other site was selected for the examination. After 60 seconds, the strip in the sulcus was removed and placed in a glass container with covered top.

Results: The mean age of the patients was 24.3±3.1 years, ranging from 15-32 years. There is a significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. The number of patients with moderate or severe inflammation increased with simultaneous decrease in patients with normal healthy gingivae or mild inflammation.

Conclusion: Patients with fixed orthodontic treatment has increased concentration of nickel and chromium in the GCF. We also observed that the gingival health also deteriorates with subsequent visits.

Keywords: Chromium Ions, Brackets, Bands, Arch Wires, Springs.

INTRODUCTION

The stainless steel used in orthodontic clinics is of type 302 or 304 and both the types contain 8–10% nickel. Usually Fixed orthodontic appliances are made up of stainless steel, nickel–titanium, or nickel–cobalt alloys which includes brackets, bands, arch wires, and springs. Orthodontic alloys contain chromium and nickel which may cause contact allergy, asthma, or hypersensitivity reactions.^{1, 2} Release of nickel and chromium ions into saliva can occur due to the corrosion of orthodontic alloys which may influence on systemic levels.³ Exposure biomarkers are used to measure the systemic effects. Medium for systemic exposure with reasonable sensitivity might be gingival crevicular fluid (GCF), which is a unique biologic exudate that

can be collected noninvasively. Unlike all other biomarkers of exposure (blood, urine, hair), GCF is directly related to the inflammatory response induced by orthodontic forces.⁴⁻⁶ GCF might be one of the most relevant biomarkers of exposure so, we conducted the present study to estimate the concentration of nickel and chromium in the GCF of patients with fixed orthodontic treatment.

MATERIALS AND METHODS

50 orthodontics patients were selected from the OPD. Out of 50 patients, 30 were females and 20 were males.

Received: July. 9, 2020: Accepted: Aug. 15, 2020

*Correspondence Dr. Daya Shankar.

Department of Dentistry, Patna Medical College and hospital, Patna, Bihar, India.

Email: Not Disclosed

The ethical clearance was obtained from the institutional ethical committee. After explaining procedure of the study a written informed consent was obtained from each patients who were participating into the study.

Method for GCF collection

- 4 sites were randomly chosen for each patient to avoid any bias related to site of collection of GCF.
- The gingiva was not flushed to counteract evacuation of the GCF and the gingiva on all sides of teeth was lightly air dried to wipe out salivary residues.
- The area was isolated using cellulose strips.
- The GCF collection was done using cellulose acetic acid derivation spongy strip with 45-mm micropores .
- The PerioPaper strips were gently placed in the sulcus for 60 seconds.
- If bleeding was observed at the site of examination, that site was discarded and other site was selected for the examination.
- After 60 seconds, the strip in the sulcus was removed and placed in a glass container with covered top.
- 4 strips were loaded in each glass container.
- The samples were refrigerated at 10C for maximum of 1 week and were sent to lab for further evaluation.
- The sites examined at first visit, were reexamined at 2nd and 3rd visits.
- The PerioPaper strips were weighed before and after the examination to calculate the weight of the GCF collected.

Assessment of Gingival health-

Loe's gingival index-

- gingival health was categorised as ,0 for no inflammation

- 1 for Mild inflammation, slight discoloration, slight edema, absence of ulceration or contionous bleeding
- 2 for moderate inflammation and positive bleeding on probing
- 3 for severe inflammatory response, ulceration alongside spontaneous bleeding.

Statistical Analysis

The statistical analysis of the data was done using SPSS version 11.0. Chi-square and Student's t-test were used for checking the significance of the data. A p value of 0.05 and lesser was considered statistically significant.

RESULTS

The mean age of the patients was 24.3±3.1 years, ranging from 15-32 years. There is a significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. (table-1) The number of patients with moderate or severe inflammation increased with simultaneous decrease in patients with normal healthy gingivae or mild inflammation. (Table-2 and fig-1)

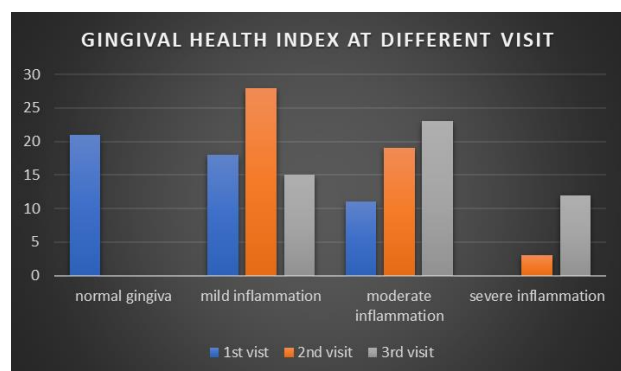
Table 1: Nickel and chromium concentration in GCF

Variables	Visit number		
	1 st visit (baseline)	2 nd visit (after 1 month)	3 rd visit (after 6 months)
Value of Nickel in GCF (µg/g)	6.01±0.11	7.2±1.01	17.20±4.1
Value of Chromium in GCF (µg/g)	2.91±0.8	6.0±0.8	11.6±2.2

Table 2: Gingival health index at different visits.

Visit number	No. of patients (n=50)			
	Normal gingivae	Mild inflammation	Moderate inflammation	Severe inflammation
1 st visit (baseline)	21	18	11	0
2 nd visit	0	28	19	3
3 rd visit	0	15	23	12

Fig 1: Gingival health index at different visits.



DISCUSSION

In the present study, we observed significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. Also, on subsequent visits, the number of patients with moderate or severe inflammation increased with simultaneous decrease in patients with normal healthy gingivae or mild inflammation. The results were compared with previous studies where they assessed the levels of nickel and chromium in GCF. Nickel and chromium concentrations were measured before treatment and 1 month and 6 months later in 12 female and 12 male patients who had fixed orthodontic appliances using atomic absorption spectrophotometry. The gingival index worsened over time. The mean nickel levels were 3.894 ± 1.442 , 5.913 ± 2.735 , and 19.810 ± 8.452 μg per gram, respectively, at baseline, month 1, and month 6. Chromium concentrations were 1.978 ± 0.721 , 4.135 ± 1.591 , and 13.760 ± 3.555 μg per gram, respectively. Compared with the baseline, nickel increased by 150% and 510%, respectively, in the first and sixth months, and chromium increased by 200% and 700%, respectively. They concluded that six months of fixed orthodontic treatment might intensify the levels of nickel and chromium in the GCF as well as gingival inflammation.⁷

Another study assessed and evaluated the changes occurring in nickel and chromium levels in the GCF during fixed orthodontic treatment. At baseline (pretreatment time), 1 month after the start of orthodontic treatment, and at 6 months after the commencement of orthodontic treatment. Cellulose strips were used for isolation of the tooth region. For GCF collection, a standardized cellulose acetate absorbent strip was used. At 1 month, the mean

value of nickel and chromium in GCF was found to be 4.5 and 4.9 $\mu\text{g}/\text{gm}$ of GCF respectively. While comparing the mean nickel levels between 1 and 6 months and between baseline and 6 months, significant results were obtained. Significant results were also obtained while comparing the mean values of chromium in GCF between baseline and 6 months and between 1 and 6 months. Gingival health index of the patients was found to be associated with increased inflammation with the progression of time of orthodontic treatment. They concluded that the levels of nickel and chromium might show considerable elevation in the GCF with time along with an increase in the severity of inflammation in the gingival health in patients undergoing fixed orthodontic treatment.⁸ An study examined whether orthodontic treatment induces an increase in salivary nickel and chromium concentration. This study showed that there was a statistically significant difference in salivary nickel and chromium concentrations before and 1 week and 3 weeks after insertion of fixed orthodontic appliances. The highest concentrations of nickel and chromium were found after 1 week. The salivary nickel and chromium concentrations tapered off 3 weeks after insertion but were significantly higher than baseline levels. They concluded that the salivary nickel and chromium concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels, with the maximum concentration seen in the first week after placement of fixed orthodontic appliances.⁹

According to a study, the salivary samples were taken from the patients in four stages: before appliance placement and 20 days, 3 months, and 6 months following appliance placement. It was found that the average amount of nickel in the saliva 20 days after appliance placement was 0.8 $\mu\text{g}/\text{L}$ more than before placement. Also, the amount of salivary nickel 20 days after the appliance placement was more than at the other stages, but the differences were not significant. The average amount of chromium in the saliva was found to be between 2.6 and 3.6 $\mu\text{g}/\text{L}$. The amount of chromium at all stages after appliance placement was more than before, but the differences between the chromium levels of saliva at all stages were not significant.¹⁰

CONCLUSION

Patients with fixed orthodontic treatment has increased concentration of nickel and chromium in the GCF. We also observed that the gingival health also deteriorates with subsequent visits.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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