Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr UGC approved journal no. 63854

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805 SJIF (Impact factor) 2017= 6.261; Index Copernicus value 2016 = 76.77

Original Article

Estimation of Concentration of Nickel and Chromium in the GCF of patients with Fixed Orthodontics

Sakshi Raina[1], Adarshika[2] , Hitesh Dhakad[3], Prasad Borole[4], Yogesh Phalak[5]

[1]MDS, Orthodontist, ACPM, Dental college, Dhule, Maharashtra, India
[2]Consultant Orthodontist, Lucknow, Uttar Pradesh, India,
[3,4,5]PG Student, Department of Orthodontics, ACPM, Dental College, Dhule, Maharashtra, India

***ABSTRACT*:**
Background: Fixed orthodontic appliances usually include brackets, bands, arch wires, and springs. They are made of stainless steel, nickel–titanium, or nickel-cobalt alloys. The stainless steel currently used in orthodontic clinics is of type 302 or 304, both of which contain 8–10% nickel. **Aim of the study:** To estimate concentration of nickel and chromium in the GCF of patients with fixed orthodontics. **Materials and methods:** The present study was conducted in the Department of Orthodontics of the dental institute. For the study, 60 orthodontics patients were selected from hospital's OPD clinic. Out of 60 patients, 36 were females and 24 were males. For the collection of GCF, 4 sites were randomly chosen for each patient to avoid any bias related to site of collection of GCF. The gingivae were not splashed with water or flushed to counteract evacuation of the GCF. The gingivae on all sides of teeth were lightly air dried to wipe out salivary residues. The isolation of the area was done using cellulose strips. **Results:** The mean age of the patients was 23.1$\pm$2.9 years, ranging from 14-30 years. We observed significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. We observed that 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. **Conclusion**: Within the limitations of the present study, we conclude that patients with fixed orthodontic braces has increased concentration of nickel and chromium in the GCF. The gingival health also deteriorates with subsequent visits.
Keywords: GCF, Fixed orthodontics, metal alloy, nickel

Received: 11 August 2018 Revised: 22 September 2018 Accepted: 25 October 2018

Corresponding author: Dr Sakshi Raina, 149/c Wazir Bhag, Surya-vihar, Patta Bohri, Jammu Tawi, J&K, India

This article may be cited as: Raina S, Adarshika, Dhakad H, Borole P, Phalak Y. Estimation of Concentration of Nickel and Chromium in the GCF of patients with Fixed Orthodontics. J Adv Med Dent Scie Res 2018;6(10):138-140.

INTRODUCTION:

Fixed orthodontic appliances usually include brackets, bands, arch wires, and springs. They are made of stainless steel, nickel–titanium, or nickel-cobalt alloys. The stainless steel currently used in orthodontic clinics is of type 302 or 304, both of which contain 8–10% nickel. Orthodontic alloys contain chromium and nickel which might induce contact allergy, asthma, or hypersensitivity.[1, 2] Corrosion of orthodontic alloys might release nickel and chromium ions into saliva. The influence of orthodontic treatment on systemic levels is controversial, showing increases and lack of changes.[3] Systemic exposure can be measured with exposure biomarkers. A medium for systemic exposure with reasonable sensitivity might be gingival crevicular fluid (GCF), a unique biologic exudate that can be collected noninvasively. In an orthodontic setup, GCF might be one of the most relevant biomarkers of exposure because unlike all other biomarkers of exposure (blood, urine, hair), it is directly related to the inflammatory response induced by orthodontic forces.[4-6]

Hence the present study was conducted to estimate concentration of nickel and chromium in the GCF of patients with fixed orthodontics.

MATERIALS AND METHODS:

The present study was conducted in the Department of Orthodontics of the dental institute. For the study, 60 orthodontics patients were selected from hospital's OPD

clinic. Out of 60 patients, 36 were females and 24 were males. The ethical approval for the study protocol was obtained from the institutional ethical committee. A written informed consent was obtained from each patient after explaining them the procedure of the study.

For the collection of GCF, 4 sites were randomly chosen for each patient to avoid any bias related to site of collection of GCF. The gingivae were not splashed with water or flushed to counteract evacuation of the GCF. The gingivae on all sides of teeth were lightly air dried to wipe out salivary residues. The isolation of the area was done using cellulose strips. The GCF collection was done using cellulose acetic acid derivation spongy strip with 45-mm micropores (PerioPaper strips). The PerioPaper strips were gently placed in the sulcus for 60 seconds. Only 1 mm of the strip was placed in the sulcus. If bleeding was observed at the site of examination, that site was discarded and other site was chosen for examination. If calculus at the tooth site provided hinderance to the placing of strip in the sulcus, other site was randomly chosen. In addition, after placing the strip in sulcus for 60 seconds, if the strip was not wet totally (decided visibly), the strip was discarded and another strip was used at other random site. One strip was used for only one site. After 60 seconds of placing the strip in the sulcus, the strip was removed and placed in a glass container with covered top. 4 strips were loaded in each glass container. The samples were refrigerated at 1^0C 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. The assessment of Gingival health was done using Loe's gingival index. In this index, gingival health was caytegorised as ,0 for no inflammation; 1 for Mild inflammation, slight discoloration, slight edema, absence of ulceration or contionous bleeding; @ for moderate inflammation and positive bleeding on probing; 3 for severe inflammatory response, ulceration alongside spontaneous bleeding.

The statistical analysis of the data was done using SPSS version 11.0 for windows. 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 defined to be statistical significant.

RESULTS:

The mean age of the patients was 23.1±2.9 years, ranging from 14-30 years. **Table1** shows the levels of nickel and chromium in GCF at different visits. We observed significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. **Table 2** shows the gingival health index of patients at subsequent visits. We observed that 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. [Fig 1]

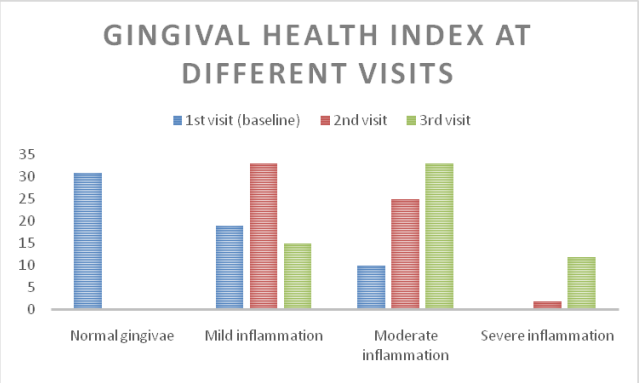
Table 1: Nickel and chromium concentration in GCF at 1st, 2nd and 3rd visit

Variables	Visit number		
	1st visit (baseline)	2nd visit (after 1 month)	3rd visit (after 6 months)
Value of Nickel in GCF (µg/g)	5.02±0.21	6.2±1.02	16.22±4.3
Value of Chromium in GCF (µg/g)	1.91±0.8	5.0±0.8	10.6±2.6

Table 2: Gingival health index at different visits

Visit number	No. of patients (n=60)			
	Normal gingivae	Mild inflammation	Moderate inflammation	Severe inflammation
1st visit (baseline)	**31**	**19**	**10**	**0**
2nd visit	**0**	**33**	**25**	**2**
3rd visit	**0**	**15**	**33**	**12**

Figure 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. Amini F et al 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. Bhasin V et al 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 ug/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.[7, 8]

Singh DP et al 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. Yassaei S et al investigated the salivary concentration of nickel and chromium of patients undergoing orthodontic treatment. In this study 32 patients who presented to the orthodontic clinic were selected. 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 μg/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 μg/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. There was no significant difference in the average amount of salivary nickel and chromium of patients at various stages of orthodontic appliance placement.[9, 10]

CONCLUSION:

Within the limitations of the present study, we conclude that patients with fixed orthodontic braces has increased concentration of nickel and chromium in the GCF. The gingival health also deteriorates with subsequent visits.

REFERENCES:

1. House K, Sernetz F, Dymock D, Sandy JR, Ireland AJ. Corrosion of orthodontic appliances—should we care? Am J Orthod Dentofacial Orthop 2008;133:584-92.
2. Amini F, Borzabadi Farahani A, Jafari A, Rabbani M. In vivo study of metal content of oral mucosa cells in patients with and without fixed orthodontic appliances. Orthod Craniofac Res 2008;11:51-6.
3. Matos de Souza R, Macedo de Menezes L. Nickel, chromium and iron levels in the saliva of patients with simulated fixed orthodontic appliances. Angle Orthod 2008;78:345-50.
4. Amini F, Jafari A, Amini P, Sepasi S. Metal ion release from fixed orthodontic appliances—an in vivo study. Eur J Orthod 2012;34: 126-30.
5. Eliades T, Athanasiou AE. In vivo aging of orthodontic alloys: implications for corrosion potential, nickel release, and biocompatibility. Angle Orthod 2002;72:222-37.
6. Hwang CJ, Shin JS, Cha JY. Metal release from simulated fixed orthodontic appliances. Am J Orthod Dentofacial Orthop 2001;120: 383-91.
7. Amini F, Shariati M, Sobouti, Rakhshan V. Effects of fixed orthodontic treatment on nickel and chromium levels in gingival crevicular fluid as a novel systemic biomarker of trace elements: A longitudinal study. Am J Orthod Dentofacial Orthop. 2016 May;149(5):666-72.
8. Bhasin V, Pustake SJ, Joshi V, Tiwari A, Bhasin M, Punia RS. Assessment of Changes in Nickel and Chromium Levels in the Gingival Crevicular Fluid during Fixed Orthodontic Treatment. J Contemp Dent Pract. 2017 Aug 1;18(8):675-678.
9. Singh DP, Sehgal V, Pradhan KL, Chandna A, Gupta R. Estimation of nickel and chromium in saliva of patients with fixed orthodontic appliances. World J Orthod. 2008 Fall;9(3):196-202.
10. Yassaei S, Dadfarnia S, Ahadian H, Moradi F. Nickel and chromium levels in the saliva of patients with fixed orthodontic appliances. Orthodontics (Chic.). 2013;14:e76-81.

Source of support: Nil **Conflict of interest:** None declared