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Measurement of Nickel and Chromium Level in GCF of Patients Undergoing Orthodontic Treatment with or Without Fluoridated Toothpaste

John Patowary
Lecturer, Department of Orthodontics and dentofacial orthopaedics, Regional Dental College Guwahati, Assam, India

Daya Shankar
Ex- Assistant Professor, Department of Dentistry, Patna Medical College and Hospital, Patna-4, Bihar, India

***Abstract*---**Background: Nickel-containing alloys exist in a wide variety of appliances and auxiliary devices used in orthodontics. The present study was conducted to assess nickel and chromium level in GCF in patients undergoing orthodontic treatment. Materials & Methods: 50 patients undergoing fixed orthodontic treatment were divided into 2 groups. Group I patients underwent fixed orthodontics and were given non- fluoridated toothpaste and group II patients underwent fixed orthodontics and were given fluoridated toothpaste. Gingival crevicular fluid was obtained before appliance placement, at 1 week, 1 month, and 6 months post- operatively. Salivary nickel and chromium levels was assessed inductively coupled plasma mass spectrometry. Results: There were 10 males and 15 females in group I and 12 males and 13 females in group II. The mean nickel level before treatment in group I was 0.47 ng/ml and in group II was 0.51 ng/ml, on 7th day was 0.54 ng/ml and 0.58 ng/ml, on 1 month was 13.2 ng/ml and 98.4 ng/ml and on 6th month was 0.56 ng/ml and 0.50 in group I and II respectively.

***Keywords*---**chromium, fixed appliance, fluoridated toothpaste, nickel, orthodontic treatment.

***Corresponding author**: Shankar, D.; Email: drpatowaryjohn@gmail.com*
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Introduction

Nickel-containing alloys exist in a wide variety of appliances and auxiliary devices used in orthodontics, with a content of up to 55% by weight. Likewise, the *in vivo* release of nickel ions varies greatly from 0.5 to 105.7 µg/l, according to the alloy type, body fluid, temperature, mechanical stress, or pH. In general, orthodontic materials are considered to be highly biocompatible (Kerosuo & Kanerva, 1997).

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 (Talic et al., 2013). Orthodontic alloys contain chromium and nickel which might induce contact allergy, asthma, or hypersensitivity. 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. Systemic exposure can be measured with exposure biomarkers (Lindsten & Kurol, 1997).

Release of metallic ions, notably nickel and chromium, present in orthodontic fixed appliance attachments like brackets and arch wires has been a cause of concern in recent years (Temesvari & Racz, 1988). Although metals used in the mouth have good biocompatibility and corrosion resistance, they sometimes lose their stable surface oxide layer, leading to leaching of metallic ions when exposed to the intraoral environment causing allergies, hypersensitivity and alterations in cellular morphology and characteristics (Rahilly & Price, 2003). Fluorides prescribed for use during orthodontic treatment have a deleterious effect of promoting leaching of ions by creating an acidic environment. Studies comparing in vitro and in vivo orthodontic appliance metal ion leaching have shown variable results. Appreciable increase in amounts of metal ions released in vitro (Staerkjaer & Menné, 1990). The present study was conducted to assess nickel and chromium level in GCF in patients undergoing orthodontic treatment.

Materials & Methods

The present study comprised of 50 patients undergoing fixed orthodontic treatment of both genders. All were informed regarding the study and written consent was obtained. Data such as name, age, gender etc. was recorded. Patients were randomly divided into two groups of 25 each. Group I patients underwent fixed orthodontics and were given non- fluoridated tooth paste and group II patients underwent fixed orthodontics and were given fluoridated tooth paste. Gingival crevicular fluid was obtained before appliance placement, at 1 week, 1 month, and 6 months post- operatively. Salivary nickel and chromium levels was assessed inductively coupled plasma mass spectrometry. Results were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results

Table 1
Distribution of patients

Groups	Group I (Non- fluoridated toothpaste)	Group II (Fluoridated tooth paste)
M:F	10:15	12:13

Table 1 shows that there were 10 males and 15 females in group I and 12 males and 13 females in group II.

Table 2
Evaluation of nickel level

Time period	Group I	Group II	P value
Before treatment	0.47	0.51	0.72
7 days	0.54	0.58	0.86
1 month	13.2	98.4	0.01
6 months	0.56	0.50	0.94

Table 2, Figure 1 shows that mean nickel level before treatment in group I was 0.47 ng/ml and in group II was 0.51 ng/ml, on 7th day was 0.54 ng/ml and 0.58 ng/ml, on 1 month was 13.2 ng/ml and 98.4 ng/ml and on 6th month was 0.56 ng/ml and 0.50 in group I and II respectively. The difference was significant (P< 0.05).

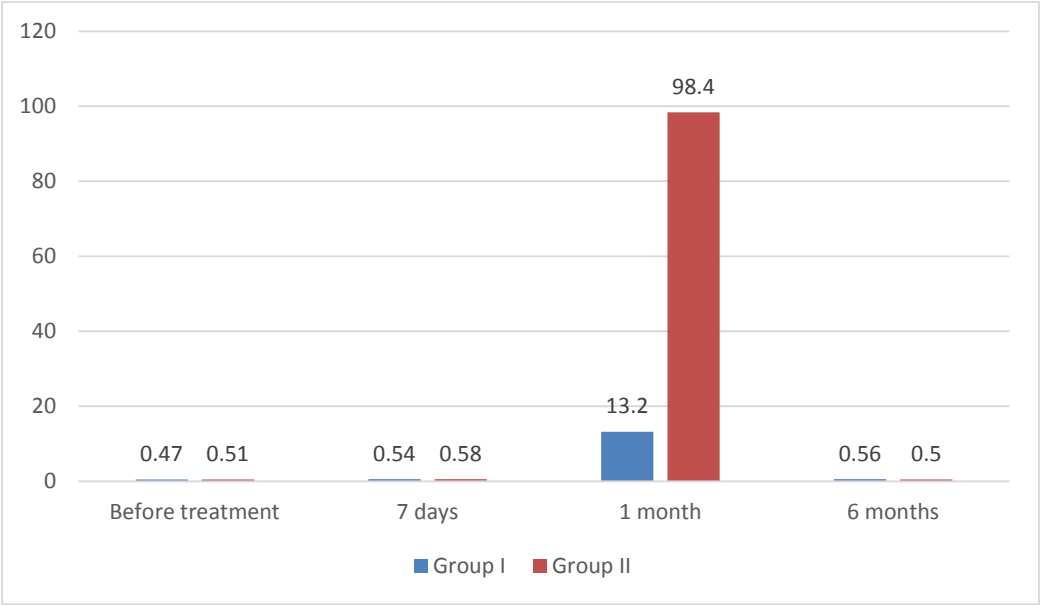

Figure 1. Evaluation of nickel level

Table 3
Evaluation of chromium level

Time period	Group I	Group II	P value
Before treatment	0.49	0.56	0.90
7 days	0.53	0.55	0.92
1 month	40.2	62.8	0.01
6 months	4.8	0.53	0.05

Table 3, Figure 2 shows that mean chromium level before treatment in group I was 0.49 ng/ml and in group II was 0.56 ng/ml, on 7th day was 0.53 ng/ml and 0.55 ng/ml, on 1 month was 40.2 ng/ml and 62.8 ng/ml and on 6th month was 4.8 ng/ml and 0.53 in group I and II respectively. The difference was significant (P< 0.05).

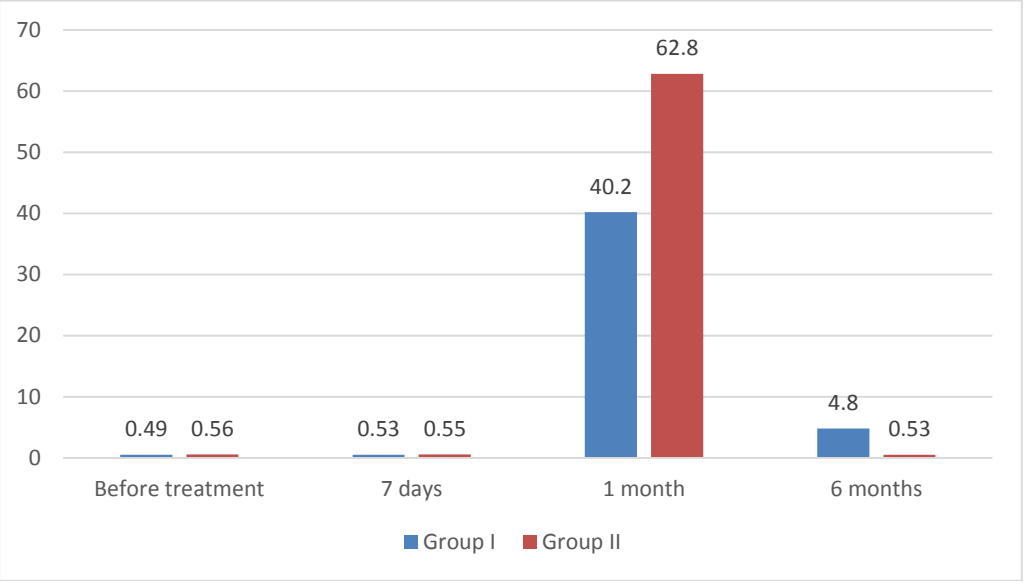

Figure 2. Evaluation of chromium level

Discussion

Orthodontic alloys contain chromium and nickel, which might induce contact allergy, asthma, or hypersensitivity (Chitra et al., 2019). Corrosion of orthodontic alloys might release nickel and chromium ions into saliva. Chromium oxide forms an anticorrosive passive film over orthodontic appliances (Ağaoğlu et al., 2001). Nevertheless, in clinical situations, this protective layer is disrupted because of mastication, brushing, thermal stresses, saliva flow, biofilm microorganisms and their by-products and enzymatic activities, recycling of appliances, friction between brackets and wires, occlusal loadings and acidic drinks, mouthwashes, or toothpastes (Amini et al., 2014). The present study was conducted to assess nickel and chromium level in GCF in patients undergoing orthodontic treatment.

In present study, there were 10 males and 15 females in group I and 12 males and 13 females in group II. (Raina et al. (2018), assessed concentration of nickel and chromium in the GCF of patients with fixed orthodontics in 60 patients. 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. The mean age of the patients was 23.1+2.9 years, ranging from 14-30 years. They observed significant increase in the mean level of nickel from 1st visit to 3rd visit and from 2nd visit to 3rd visit. They 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.

We found that mean nickel level before treatment in group I was 0.47 ng/ml and in group II was 0.51 ng/ml, on 7th day was 0.54 ng/ml and 0.58 ng/ml, on 1 month was 13.2 ng/ml and 98.4 ng/ml and on 6th month was 0.56 ng/ml and 0.50 in group I and II respectively. Singh et al. (2018), examined whether orthodontic treatment induces an increase in salivary nickel and chromium concentration. 10 new patients beginning fixed orthodontic treatment were included. The mean age of the sample was 17.5 years (range 14 to 24 years). Three samples of stimulated saliva were collected from each orthodontic patient, 1 at each of the following times: before insertion of the fixed appliance (which served as a baseline/reference level for salivary nickel and chromium content), 1 week after insertion of the appliance, and 3 weeks after insertion of the appliance. These samples were analyzed for nickel and chromium content using the atomic absorption spectrometer and their values recorded in ng/mL. 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.

We observed that mean chromium level before treatment in group I was 0.49 ng/ml and in group II was 0.56 ng/ml, on 7th day was 0.53 ng/ml and 0.55 ng/ml, on 1 month was 40.2 ng/ml and 62.8 ng/ml and on 6th month was 4.8 ng/ml and 0.53 in group I and II respectively. Pritam et al. (2021), in their study 40 patients undergoing fixed orthodontic treatment were divided into 2 groups of 20 each. Group I was fixed orthodontic treatment group and was given non-fluoridated toothpaste and Group II was fixed orthodontic treatment group and was given fluoridated toothpaste. The assessment of salivary nickel and chromium levels was done using inductively coupled plasma mass spectrometry. In group I, there were 6 male and 14 female and in group II 7 males and 13 females. The mean nickel level (ng/ml) before treatment in group I was 0.49 and in group II was 0.52, on 7th day was 0.52 and 0.54, on 30th day was 13.4 and 100.2, and on 6th month was 0.54 and 0.52 in Group I and II, respectively. The mean chromium level (ng/ml) before treatment in Group I was 0.48 and in Group II was 0.52, on 7th day was 0.52 and 0.53, on 30th day was 40.6 and 62.4 and on

6th month was 4.9 and 0.52 in Group I and II, respectively. The difference was significant ($P < 0.05$).

Conclusion

Authors found that in patients undergoing fixed orthodontics the release of nickel and chromium ions was more with fluoridated toothpaste as compared to non-fluoridated toothpaste.

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