

## Original Research

### Assessment of salivary nickel levels in patients undergoing fixed orthodontic treatment

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#### ABSTRACT:

**Background:** We planned the present study to assess the salivary nickel levels in patients undergoing fixed orthodontic treatment. **Materials & methods:** A total of 40 subjects undergoing fixed orthodontic treatment were enrolled in the present study. A total of 40 age and gender matched healthy controls were also included in the present study. All the subjects were called in the morning and fasting salivary samples were collected in cold polypropylene tube. Before sample collection, subjects were instructed to rinse their oral cavity from 25 to 30 seconds. All the samples were sent to laboratory for further assessment. In the laboratory, the assessment of salivary nickel levels was done using atomic absorption spectrophotometer.

**Results:** Mean salivary nickel levels among the patients of the study group were 20.6 ng/ml and were significantly higher in comparison to the mean salivary nickel levels among the patients of the control group (13.9 ng/ml). **Conclusion:** Corrosion of fixed orthodontic appliances leads to elevated salivary nickel levels early after the initiation of orthodontic treatment.

**Key words:** Salivary, Nickel

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#### INTRODUCTION

Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented. Fixed orthodontic appliances including brackets and arches are commonly made of stainless steel and nickel-titanium (NiTi) alloys and, therefore, have corrosion potential in the oral environment. The amount of nickel as the main constituent of contemporary orthodontic appliances may vary from 8% in stainless steel to more than 50% in NiTi alloys. Stainless-steel alloys include 17% to 22% of chromium. Fixed orthodontic treatment causes major changes in the composition of the saliva.<sup>1-3</sup> Nickel and chromium ions released from fixed orthodontic appliances can serve as allergens or may have serious biological side effects. Moreover, they are cytotoxic, mutagenic, and carcinogenic in small quantities in the range of nanograms. Evaluation of the level of trace elements in patients using orthodontic appliances is a priority. Both nickel and chromium ions can cause

hypersensitivity reactions in some people. In addition, nickel and chromium can cause dermatitis and asthma. Increased prevalence of nickel hypersensitivity as well as the increased demand and availability of orthodontic treatment have attracted the attention of researchers towards the composition of alloys and their ion release potential during orthodontic treatment. Orthodontic appliances (brackets and wires) exposed to the oral environment are affected by thermal alterations in the oral cavity and pH, constant presence of saliva, exposure to foods and drinks, mechanical loads applied to them, and abrasion. They are subjected to aging as such and may undergo dissolution or oxidation. The placement of archwires can cause an increase in salivary nickel and chromium levels and, therefore, nickel may be released from the wires as well as bands and brackets.<sup>4-6</sup>

It is well known that oral cavity is an ecosystem which is known to cause biodegradation of metals

which usually occurs through the process of electrochemical breakdown. Besides, it is known that various orthodontic components such as nickel and chromium can cause hypersensitivity reactions in the oral cavity, cytotoxicity, and dermatitis.<sup>7</sup> Hence; we planned the present study to assess to salivary nickel levels in patients undergoing fixed orthodontic treatment.

## MATERIALS & METHODS

The present research was planned with the aim of assessing nickel ion concentration in subjects undergoing orthodontic treatment. A total of 40 subjects undergoing fixed orthodontic treatment were enrolled in the present study. A total of 40 age and gender matched healthy controls were also included in the present study. Inclusion criteria for the present study included:

- Patients undergoing fixed orthodontic treatment,
- Patients less than 20 years of age
- Patients in which orthodontic treatment has been started from at least past one year

All the subjects were called in the morning and fasting salivary samples were collected in cold polypropylene tube. Before sample collection, subjects were instructed to rinse their oral cavity from 25 to 30 seconds. All the samples were sent to laboratory for further assessment. In the laboratory, the assessment of salivary nickel levels was done using atomic absorption spectrophotometer. All the results were compiled in Microsoft excel sheet and were analyzed by SPSS software. Mann-Whitney U test was used for assessment of level of significance. P- value of less than 0.05 was taken as significant.

## RESULTS

Mean age of the patients of the study group and control group was 18.4 years and 16.8 years respectively. There were 22 males in study group and 25 males in the control group. Mean salivary nickel levels among the patients of the study group were 20.6 ng/ml and were significantly higher in comparison to the mean salivary nickel levels among the patients of the control group (13.9 ng/ml).

Table 1: Demographic details

Parameter	Study group	Control group
Mean age (years)	18.4	16.8
Gender	Males	22
	Females	18

Table 2: Comparison of salivary nickel levels among subjects of two study groups

Parameter	Study group	Control group	P-value
Mean Salivary nickel levels (ng/ml)	20.6	13.9	0.01*
SD	6.7	3.8	

\*: Significant

## DISCUSSION

Nickel (Ni) and chromium (Cr) containing alloys are present in great numbers in a wide variety of appliances, auxiliaries, and utilities used in orthodontics and thus become an integral part of almost every routine orthodontic intervention. The use of various combinations of metal alloys for prolonged durations in orthodontic patients warrants special consideration regarding their biocompatibility. The oral cavity is a complete corrosion cell, with many factors that enhance the biodegradation of orthodontic appliances.<sup>8,9</sup> Hence; we planned the present study to assess to salivary nickel levels in patients undergoing fixed orthodontic treatment.

In the present study, mean age of the patients of the study group and control group was 18.4 years and 16.8 years respectively. There were 22 males in study group and 25 males in the control group. Mean salivary nickel levels among the patients of the study group were 20.6 ng/ml and were significantly higher in comparison to the mean salivary nickel levels among the patients of the control group (13.9 ng/ml). Amini F et al evaluated salivary levels of nickel and chromium in periodontal patients (versus healthy controls) under orthodontic treatment for 2 months. In this in vivo study, 40 subjects were evaluated. Patient selection and standardization of orthodontic treatment protocols were prospectively designed and performed. Two groups of n = 20 each (control: healthy orthodontic patients, cohort: orthodontic patients with periodontitis) underwent similar protocols of fixed orthodontic treatment for 2 months. After 2 months, salivary nickel and chromium concentrations of the case and cohort groups were measured using inductively coupled plasma mass spectrometry (ICP-MS). The values were compared between the two groups using t test. There were 10 men and 10 women in each group. The mean age of patients was  $34.6 \pm 3.6$  years old. The salivary level of nickel was  $338.2 \pm 235.5$  ng/ml and  $182.8 \pm 116.5$  ng/ml in the cohort and control groups, respectively (P = 0.0118). The salivary level of chromium was  $7.4 \pm 3.15$  ng/ml in the cohort and  $6.35 \pm 2.39$  ng/ml in the control group (P = 0.2214). Salivary level of nickel might be considerably higher in periodontal patients undergoing 2 months of orthodontic treatment compared to orthodontic patients with healthy gingivae.<sup>10</sup> Imani MM et al reviewed the effect of fixed orthodontic treatment on salivary levels of these ions by doing a meta-analysis on cross-sectional and cohort studies. The Web of Science, Scopus, Cochrane Library, and PubMed databases were searched for articles on salivary profile of nickel or chromium in patients under fixed orthodontic treatment published from January 1983 to October 2017. A random-effect meta-analysis was done using Review Manager 5.3 to calculate mean difference (MD) and 95% confidence interval (CI), and the quality of questionnaire was evaluated by the Newcastle-Ottawa scale. Fourteen studies were

included and analyzed in this meta-analysis. Salivary nickel level was higher in periods of 10 min or less (MD = -11.5 µg/L, 95% CI = -16.92 to -6.07; P < 0.0001) and one day (MD = -1.38 µg/L, 95% CI = -1.97 to -0.80; P < 0.00001) after initiation of treatment compared to baseline (before the insertion of appliance). Salivary chromium level was higher in periods of one day (MD = -6.25 µg/L, 95% CI = -12.00 to -0.49; P = 0.03) and one week (MD = -2.07 µg/L, 95% CI = -3.88 to -0.26; P = 0.03) after the initiation of treatment compared to baseline. Corrosion of fixed orthodontic appliances leads to elevated salivary nickel and chromium concentrations early after initiation of orthodontic treatment.<sup>11</sup>

## CONCLUSION

Corrosion of fixed orthodontic appliances leads to elevated salivary nickel levels early after the initiation of orthodontic treatment.

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