

Original ARTICLE

Estimation of salivary nickel levels in patients undergoing orthodontic treatment: An observational study

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ABSTRACT

Background: In orthodontics, the various components of fixed appliances are fabricated by the use of varying materials which have their own physical and mechanical properties. Appliances become weak due to the action of all these agents and start releasing Ni, chromium, and so on, into the oral cavity. Hence; the present study was conducted for estimating salivary nickel (Ni) levels in patients undergoing orthodontic treatment. **Materials & methods:** A total of 35 patients who underwent fixed orthodontic treatment were enrolled. Cephalometric analysis was done in all the patients and treatment planning was done. All the patients were recalled in the morning before the starting of the study and salivary samples were obtained in test tubes. Fixed orthodontic treatment was started. All the patients were recalled after one month on follow-up and salivary samples were obtained again in the similar fashion. Third salivary samples were obtained on six months follow-up. All the samples were sent to laboratory where auto-analyser was used for assessment of salivary nickel levels. **Results:** At the baseline levels, mean salivary nickel levels were found to be 1.35 µg/L. At one month and six months follow-up, mean salivary nickel levels were found to be 5.58 µg/L and 3.49 µg/L respectively. While comparing the salivary nickel levels at different time intervals, significant results were obtained. **Conclusion:** Fixed orthodontic treatment results in transient rise in salivary nickel levels.

Key words: Orthodontic, Nickel, Salivary

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INTRODUCTION

In orthodontics, the various components of fixed appliances are fabricated by the use of varying materials which have their own physical and mechanical properties. Stainless steel is most commonly used for the construction of these components such as wires, brackets, bands, buccal tubes, and other auxiliaries due to its low cost, high strength, resistance to corrosion, and biocompatibility. According to the clinical needs, besides stainless steel wires, other wires such as Ni-Ti, beta titanium, cobalt chromium, and teflon polyethylene coated wires are also used.¹⁻³

Corrosion of materials occurs inside the oral cavity due to numerous environmental or oral factors that act on them. These factors include temperature, pH variation, salivary conditions, mechanical loads, microbiological and enzymatic activity, and various food components. Appliances become weak due to the action of all these agents and start releasing Ni, chromium, and so

on, into the oral cavity. Important role is played by Ni and chromium which come under the category of trace elements.⁴⁻⁶ Hence; the present study was conducted for estimating salivary nickel levels in patients undergoing orthodontic treatment.

MATERIALS & METHODS

The present study was conducted for estimating salivary nickel levels in patients undergoing orthodontic treatment. A total of 35 patients who underwent fixed orthodontic treatment were enrolled. Inclusion criteria for present study included:

- Patients less than 25 years of age,
- Patients with negative history of any other systemic illness,
- Patients with any known drug allergy,
- Patients with negative history of diabetes or hypertension

Cephometric analysis was done in all the patients and treatment planning was done. All the patients were recalled in the morning before the starting of the study and salivary samples were obtained in test tubes. Fixed orthodontic treatment was started. All the patients were recalled after one month on follow-up and salivary samples were obtained again in the similar fashion. Third salivary samples were obtained on six months follow-up. All the samples were sent to laboratory where auto-analyser was used for assessment of salivary nickel levels. p- value of less than 0.05 was taken as significant.

RESULTS

In the present study, analysis of a total of 35 patients scheduled to undergo fixed orthodontic treatment was done. Mean age of patients was found to be 14.9 years. Majority of the patients were of urban residence and most of them were males. At the baseline levels, mean salivary nickel levels were found to be 1.35 µg/L. At one month and six months follow-up, mean salivary nickel levels were found to be 5.58 µg/L and 3.49 µg/L respectively. In the present study, while comparing the salivary nickel levels at different time intervals, significant results were obtained.

Table 1: Salivary nickel levels

Time interval	Mean salivary nickel levels (µg/L)
Baseline	1.35
One month follow-up	5.48
Six months follow-up	3.49

Table 2: Comparison of salivary nickel levels at different time intervals

Comparison	t-value	p-value
Baseline Vs One month follow-up	-1.450	0.00*
One month follow-up Vs Six months follow-up	-1.992	0.00*
Baseline Vs Six months follow-up	-1.745	0.01*

*: Significant

DISCUSSION

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.^{7, 8}

In higher doses, both Ni and Cr have been found to be harmful. Nickel has been systematically studied for detrimental effects at cell, tissue, organ, and organism levels. In higher doses, Ni can be an allergen or carcinogenic and act as a mutagenic substance by causing alteration in DNA. Higher doses of chromium are also capable of inducing side effects which may include insomnia or irregular sleeping, headaches, vomiting, diarrhea, and irritability.⁹ Hence; the present study was conducted for estimating salivary nickel levels in patients undergoing orthodontic treatment.

In the present study, analysis of a total of 35 patients scheduled to undergo fixed orthodontic treatment was done. Mean age of patients was found to be 14.9 years. At the baseline levels, mean salivary nickel levels were found to be 1.35 µg/L. At one month and six months follow-up, mean salivary nickel levels were found to be 5.58 µg/L and 3.49 µg/L respectively. Singh et al studied the level of Ni and Cr in the saliva of 10 patients with fixed orthodontic appliances from the beginning of their treatment. The highest level was found 1 week after appliance placement. Barrett et al concluded that the release rates of Ni and Cr from stainless-steel and NiTi arch wires were not significantly different. Previous studies have examined Ni release from different arch wires and have concluded that the maximum amount of Ni released from all tested arch wires was 700 times lower than the concentrations necessary to elicit cytotoxic reactions in humans (Jia et al).¹⁰⁻¹² A study by Ağaoğlu et al showed that chromium in saliva reached the highest level in the 1st month and then decreased to the initial level at the end of treatment and showed statistically significant increase in chromium levels in serum in the 2nd year groups. Kerosuo et al found no significant increase in chromium levels in saliva before and after 1 month of orthodontic treatment. Whereas, a study by Kocadereli et al found a significant increase in salivary chromium level during the first 2 months of treatment.¹³⁻¹⁵

In the present study, while comparing the salivary nickel levels at different time intervals, significant results were obtained. Nayak et al reported a statistically significant increase in chromium ion concentration after the initial aligning phase and a net increase of 17.92 ppb was found at the end of 10–12 months, which were statistically significant. A positive correlation was found for the increase in chromium ion concentration after the initial alignment and at the end of 10–12 months.¹⁶ 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. Salivary nickel level was higher in periods of 10 min or less and one day after initiation of treatment compared to baseline (before the insertion of appliance). Salivary chromium level was higher in periods of one day and one week 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.¹⁷

CONCLUSION

From the above results, the authors conclude that fixed orthodontic treatment results in transient rise in salivary nickel levels.

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