



Analysis of nickel levels in the saliva of patients undergoing fixed orthodontic treatment: An observational study

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Abstract

Background: To assess the nickel levels in the saliva undergoing fixed orthodontic treatment.

Materials & methods:A total of 100 patients who were under 30 years old and were slated to have fixed orthodontic treatment were enrolled. In order to establish a baseline for salivary nickel levels, each orthodontic patient had two samples of stimulated saliva taken: before the fixed device was put in place and 10 days later. The results were assessed using SPSS software. These samples' nickel concentrations were measured with an autoanalyzer and their results were given in micro g/L.

Results:Mean age of the patients was 22.4 years. Amount of salivary nickel at the baseline was 6.1 micro gram/L. There was slight increase in the measurement after 12 days of orthodontic treatment and the levels of nickel were 9.3 micro gram/ L. Significant results were obtained while comparing the nickel levels at different time intervals.

Conclusion: When compared to baseline values, salivary nickel and chromium concentrations considerably increased after the placement of fixed orthodontic appliances.

Keywords: Orthodontic, Treatment, Saliva

Introduction

Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented.¹ 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.² The amount of nickel as the main constituent of contemporary orthodontic appliances³ may vary from 8% in stainless steel^{4,5} to more than 50% in NiTi alloys. Stainless-steel alloys include 17% to 22% of chromium.⁶ Fixed orthodontic treatment causes major changes in the composition of the saliva.⁷ Nickel 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.⁸ Nickel ions can cause hypersensitivity reactions in some people.⁹ In addition, nickel can cause dermatitis and asthma.¹⁰

Hence, this study was conducted to assess the nickel levels in the saliva undergoing fixed orthodontic treatment.

Materials & methods

A total of 100 patients who were under 30 years old and were slated to have fixed orthodontic treatment were enrolled. In order to establish a baseline for salivary nickel levels, each orthodontic patient had two samples of stimulated saliva taken: before the fixed device was put in place and 10 days later. The results were assessed using SPSS software. These samples' nickel concentrations were measured with an autoanalyzer and their results were given in micro g/L.

Results

Mean age of the patients was 22.4 years. Amount of salivary nickel at the baseline was 6.1 micro gram/L. There was slight increase in the measurements after 12 days of orthodontic treatment and the levels of nickel were 9.3 micro gram/ L. Significant results were obtained while comparing the nickel levels at different time intervals.

Table 1: Salivary nickel and chromium (micro gram/ L) at different time intervals

Metal	Baseline	(before	After 12 days of orthodontic	P – value
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	treatment)	treatment	
Mean Nickel	6.1	9.3	0.000 (Significant)

Discussion

It has been shown that nickel ions can cause hypersensitivity reactions, dermatitis, and asthma; thus, nickel ions released from stainless-steel orthodontic bands, brackets, and wires are likely to cause allergic reactions.¹¹ The composition of saliva may be affected by many physiological variables such as time of the day, health conditions, diet¹², and salivary flow rate.¹³ The emotional state also affects the salivary flow rate; for example, anxiety and depression can cause dry mouth.¹⁴ The large variations in nickel levels reported in studies might be explained by the differences in saliva composition and pH, which are influenced by various physiological and environmental factors such as time of the day, diet, health, and mental conditions as well as nickel adhesion to epithelial cells, bacteria, macromolecules of the saliva^{15,16} and the method of sampling.^{17,18}

Hence, this study was conducted to assess the nickel and chromium levels in the saliva undergoing fixed orthodontic treatment.

In this study, mean age of the patients was 22.4 years. Amount of salivary nickel at the baseline was 6.1 micro gram/ L. There was slight increase in the measurements after 12 days of orthodontic treatment and the levels of nickel were 9.3 micro gram/ L. Significant results were obtained while comparing the nickel levels at different time intervals.

In a study by Yassaei S et al¹⁹, 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. The salivary samples were collected in a plastic tube and were stored in the freezer before analysis. The samples were then transferred to the laboratory, and the amounts of metals were determined by graphite furnace atomic absorption spectrometry with an autosampler. Each sample was analyzed three times, and the average was reported. 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.

Imani, M. M., et al²⁰ 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 Eur. Chem. Bull. 2023, 12(Issue 8),1583-1588

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 and one day after initiation of treatment compared to baseline (before the insertion of appliance).

Conclusion

When compared to baseline values, salivary nickel concentrations considerably increased after the placement of fixed orthodontic appliances.

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