

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

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Abstract

Background: To evaluate the nickel concentrations in the saliva of patients undergoing fixed orthodontic treatment.

Materials & methods: One hundred people below the age of thirty who were all set to have permanent orthodontic treatment were included. In order to get an idea of what the patients' baseline nickel levels were like, we took two samples of stimulated saliva before and after the fixed device was placed. The results were analyzed with SPSS. These samples' nickel values were measured by autoanalyzer and reported in micro g/L.

Results: The average age of the patients was 23.2 years. At the start of the trial, the mean concentration of nickel in participants' saliva was 4.3 micrograms/L. There was a slight improvement in the measurements and the nickel levels were 12.9 micrograms per liter after twelve days of orthodontic treatment. Nickel levels throughout time were compared, and substantial differences were revealed.

Conclusion: Salivary nickel and chromium levels increased after the placement of fixed orthodontic appliances compared to pre-treatment levels.

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 appliances [3] may vary from 8% in stainless steel [4,5] to more than 50% in NiTi alloys [4]. Stainless-steel alloys include 17% to 22% of chromium [6]. Fixed orthodontic treatment causes major changes in the composition of the saliva [7]. Nickel and chromium ions released from fixed orthodontic appliances can serve as allergens or may have serious biological side effects [2,6]. Moreover, they are cytotoxic, mutagenic, and carcinogenic in small quantities in the range of nanograms [2]. Evaluation of the level of trace elements in patients using orthodontic appliances is a priority [8]. Both nickel and chromium ions can cause hypersensitivity reactions in some people [9]. In addition, nickel and chromium can cause dermatitis and asthma [10].

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

Materials & methods

One hundred people below the age of thirty who were all set to have permanent orthodontic treatment were included. In order to get an idea of what the patients' baseline nickel levels were like, we took two samples of stimulated saliva before and after the fixed device was placed. The results were analyzed with SPSS. Using an autoanalyzer, we were able to calculate the micro g/L amounts of nickel in these samples.

Results

The average age of the patients was 23.2 years. At the start of the trial, the mean concentration of nickel in participants' saliva was 4.3 micrograms/L. There was a slight improvement in the measurements and the nickel levels were 12.9 micrograms per liter after twelve days of orthodontic treatment. Nickel levels throughout time were compared, and substantial differences were revealed.

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

Metal	Baseline (before treatment)	After 12 days of orthodontic treatment	P – value
Mean Nickel	4.3	12.9	0.001 (Significant)

Discussion

Biocompatibility should be carefully considered when using multiple metal alloys for extended periods of time in orthodontic patients. Many variables in the oral cavity hasten the biodegradation of orthodontic appliances, making it a full corrosion cell.[11]

Electron and ion conduction occurs in saliva, and changes in pH and temperature, microbial and enzyme activity, and the many substances consumed and consumed in the mouth all contribute to the corrosion of teeth and gums. The corrosion process is complicated by a number of factors, including the intrinsic heterogeneity of each metal alloy and its use with other alloys, the microsurface discontinuity, the forces operating on the appliances, and the friction between wires and brackets.[12]

In the intraoral environment of a typical orthodontic patient, nickel-titanium (NiTi) archwires are the richest source of nickel, with 47–50% nickel. Nickel in its many compounds and forms has been linked to carcinogenic, mutagenic, cytotoxic, and allergic effects in recent studies.[13] Factors such as time of day, diet, health, and mental state, as well as nickel adhesion to epithelial cells, bacteria, and macromolecules of the saliva and the method of sampling, may all contribute to the wide range of nickel concentrations reported in studies [14]. Hence, this study was conducted to assess the nickel and chromium levels in the saliva undergoing fixed orthodontic treatment.

In this study, the average age of the patients was 23.2 years. At the start of the trial, the mean concentration of nickel in participants' saliva was 4.3 micrograms/L. There was a slight improvement in the measurements and the nickel levels were 12.9 micrograms per liter after twelve days of orthodontic treatment. Nickel levels throughout time were compared, and substantial differences were revealed.

Yassaei Set al [15]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. 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. 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.

Imani, M. M., et al[16]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 and one day after initiation of treatment compared to baseline (before the insertion of appliance).

Conclusion

Salivary nickel and chromium levels increased after the placement of fixed orthodontic appliances compared to pre-treatment levels.

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