International Journal of Research in Health and Allied Sciences

Journal home page: www.ijrhas.com

Official Publication of "Society for Scientific Research and Studies" [Regd.]

ISSN: 2455-7803

Original Research

Nickel levels in the saliva of patients undergoing fixed orthodontic treatment

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ABSTRACT:

Background: To evaluate the nickel levels in the saliva of patients undergoing fixed orthodontic treatment. **Materials & methods:** A total of 40 patients were enrolled. 28 were female and 12 were male with fixed orthodontic treatment. Mean age was 18.7 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 level for salivary nickel content), 10 days after insertion of the appliance, and 6months after insertion of the appliance. **Results:** Amount of salivary nickel at the baseline was 1.36. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 micro gram/ L. **Conclusion:** The salivary nickel concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels.

Keywords: nickel, saliva, orthodontics.

Received: 12 October, 2022 Accepted: 16 November, 2022

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This article may be cited as: Chaudhary R. Nickel levels in the saliva of patients undergoing fixed orthodontic treatment. Int J Res Health Allied Sci 2022; 8(6):34-36.

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.[1] 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.[2] 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.Various factors such as temperature, pH variation, salivary conditions, mechanical loads, microbiological and enzymatic activity, physical and chemical properties of food and oral health conditions provide an environment for the corrosion of dental materials. [3,4]

Fixed orthodontic appliances contain variable amounts of nickel (Ni) and chromium (Cr). The stainless-steel metal used for orthodontic appliances contains 18% Cr and 8% Ni. Orthodontic arch wires made from nickel titanium (NiTi) contain 50% Ni. Fixed orthodontic appliances release Ni and Cr into the saliva as a result of electrochemical breakdown, which may lead to a "hypersensitivity" response. [5] Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented.[6] 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.[7] 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. [8] Stainless-steel alloys include 17% to 22% of chromium.[9] Fixed orthodontic treatment causes major changes in the composition of the saliva. [10] Nickel and chromium ions released from fixed orthodontic appliances can serve as allergens or may have serious biological side effects.[7] Moreover, they are cytotoxic, mutagenic, and carcinogenic in small quantities in the range of nanograms.[7] Evaluation of the level of trace elements in patients using orthodontic appliances is a priority.[11] Both nickel and chromium ions can cause hypersensitivity reactions in some people.[12] In addition, nickel and chromium can cause dermatitis

and asthma.[13] 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. [12]Hence, this study is to evaluate the nickel levels in the saliva of patients undergoing fixed orthodontic treatment.

MATERIALS & METHODS

A total of 40 patients were enrolled. 28 were female and 12 were male with fixed orthodontic treatment. Mean age was 18.7 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 level for salivary nickel content), 10 days after insertion of the appliance, and 6months after insertion of the appliance. These samples were analyzed for nickel content using the atomic absorption spectrometer and their values recorded in micro g/L. Data was collected. Result was analysed using SPSS software.

RESULTS

A total of 40 subjects were enrolled. Amount of salivary nickel at the baseline was 1.36. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 micro gram/ L. After 6 months of orthodontic appliance placement, the nickel levels were decreased to 3.48 micro gram/L.

Table: amount of salivary nickel (micro gram/ L) at the three stages

Metal	Baseline (before treatment)	After 10 days of orthodontic treatment	After 6 months of orthodontic treatment	P - value
	Mean			
Nickel	1.36	6.3	3.48	0.3

DISCUSSION

Fixed orthodontic appliances, which contain variable amounts of Ni and Cr, can leach these metals into the saliva, which may lead to an immune response. However, previous studies have not explored the amount of Ni and Cr leached into saliva over an extended period of time. Many in-vitro studies have been conducted in the past to show the release of nickel and chromium from stimulated fixed orthodontic appliance immersed in artificial saliva, which was found below the toxic dose to humans. [14,15] To confirm the validity of the result of in-vitro studies, several in-vivo studies were carried out. [16] Hence, this study is to evaluate the nickel levels in the saliva of patients undergoing fixed orthodontic treatment.

In the present study, a total of 40 subjects were enrolled. Amount of salivary nickel at the baseline was 1.36. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 micro gram/ L.A study by Yassaei S et al, 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. 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. [17]

In the present study, after 6 months of orthodontic appliance placement, the nickel levels were decreased to 3.48 micro gram/L. Another study by Singh DP et al, ten new patients (7 females and 3 males) beginning fixed orthodontic treatment were included in the study. 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.They 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.[18]

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 [19,20], and the method of sampling (stimulated versus unstimulated saliva collection).[21] Differences in the methodology, sample size, and time periods of sample collection may explain generally lower nickel concentrations in patients treated with fixed appliances. [16]

CONCLUSION

The salivary nickel concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels, with the maximum concentration seen after 10 days of placement of fixed orthodontic appliances.

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