Research Article

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Release of Nickel and Chromium Ion in Serum from Fixed Orthodontic Appliances

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ABSTRACT

Background: Almost all fixed metallic orthodontic appliances comprise metals, such as nickel (Ni), chromium (Cr), and cobalt. The present study aimed to assess amount of nickel and chromium in saliva in patients with fixed orthodontic appliances.

Materials & Methods: The present study was conducted on 20 patients undergoing fixed orthodontic treatment of both genders. Saliva was collected before treatment, after completion of alignment and leveling with nickel-titanium wires and after 12 months. The samples were kept at −20°C. The concentration of both nickel and chromium ions was recorded in parts per billion (ppb) using inductively coupled Plasma-Mass Spectrometer.

Results: Out of 20 patients, males were 8 and females were 12. Pre- treatment value of nickel was 42.8 ppb, post- alignment was 58.6 ppb and after 12 months was 50.4 ppb. The difference was significant (P< 0.05). Pre-treatment value of chromium was 72.4 ppb, post- alignment was 94.6 ppb and after 12 months was 84.2 ppb. The difference was significant (P< 0.05).

Conclusion: Author found that there was significant increase in nickel and chromium ion concentration in saliva of patients undergoing fixed orthodontics.

Keywords: Chromium, fixed orthodontics, Nickel.

INTRODUCTION

Almost all fixed metallic orthodontic appliances comprise metals, such as nickel (Ni), chromium (Cr), and cobalt. Apart from withstanding physical, mechanical, and biological assaults, a fixed orthodontic set-up should also be biocompatible in the oral environment. Thus it become an integral part of almost every routine orthodontic intervention.[1] Some arch wires with elastic properties (shape memory alloys) can contain more than 50% nickel. Release of nickel from metallic orthodontic appliances has been observed in several in vitro studies. Nickel release in vivo in the oral cavity has been more difficult to demonstrate, although corrosion has clearly been evident in the orthodontic appliances after treatment.[2]

The use of various combinations of metal alloys for prolonged durations in orthodontic patients warrants special consideration regarding their biocompatibility. Saliva acts as an electrolyte for electron and ion conduction, and the fluctuation of pH and temperature, the enzymatic and microbial activity, and the various chemicals introduced into the oral cavity through food and drink are all corrosion conductors. The inherent heterogeneity of each metal alloy and its use with other alloys, the

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microsurface discontinuity, the forces acting on the appliances and the friction between wires and brackets also add to the corrosion process.[3] The present study aimed to assess amount of nickel and chromium in saliva in patients with fixed orthodontic appliances.

MATERIALS & METHODS

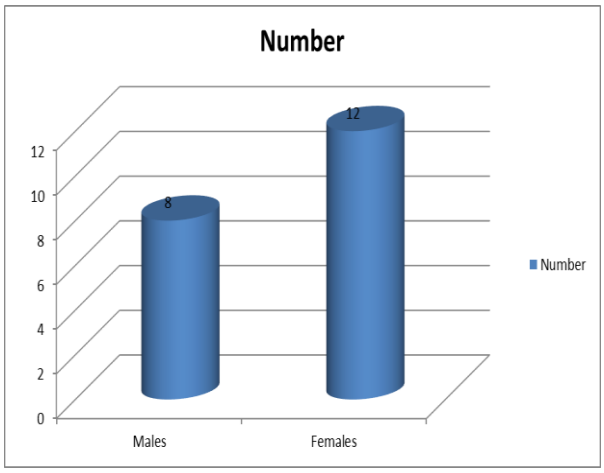
The present study was conducted in the department of Orthodontics. It comprised of 20 patients undergoing fixed orthodontic treatment of both genders. All were informed regarding the study and written consent was obtained. Ethical clearance was taken prior to the study.

General information such as name, age, gender etc. was recorded.

Patients had 0.022″ × 0.028″ slot brackets. Molars were banded with 0.022″ × 0.028″ slot buccal tubes welded onto band material. The wires were nickel-titanium wires (0.014″, 0.016″). Saliva was collected before treatment, after completion of alignment and leveling with nickel-titanium wires and after 12 months. The samples were kept at −20°C. The concentration of both nickel and chromium ions was recorded in parts per billion (ppb). Using inductively coupled Plasma-Mass Spectrometer. Results were subjected to statistical analysis. P value less 0.05 was considered significant.

RESULTS

Table I: Distribution of patients.



Graph I shows that out of 20 patients, males were 8 and females were 12.

Table II: Assessment of Nickel ions in saliva.

Duration	Mean (ppb)	P value
Pre- treatment	42.8	0.01
Post- alignment	58.6	
After 12 months	50.4	

Table I shows that pre- treatment value of nickel was 42.8 ppb, post- alignment was 58.6 ppb and after 12 months was 50.4 ppb. The difference was significant (P< 0.05).

Table II: Assessment of Chromium ions in saliva.

Duration	Mean (ppb)	P value
Pre- treatment	72.4	0.01
Post- alignment	94.6	
After 12 months	84.2	

Table II shows that pre- treatment value of chromium was 72.4 ppb, post- alignment was 94.6 ppb and after 12 months was 84.2 ppb. The difference was significant (P< 0.05).

DISCUSSION

Unsafe and hazardous materials, especially those that are used over a very long period of time and are in close contact with the oral mucosa, particularly in a wet environment, as in orthodontic therapy, should be avoided. Several studies have shown that orthodontic appliances release metal ions through emission of electro-galvanic currents, with saliva acting as the medium for continuous erosion over time.[4,5]

The amount of nickel & chromium released from fixed orthodontic appliances in vitro varies depending on the manipulation of the appliances and on different physical and chemical test condition. Nickel is the most common cause of metal induced allergic contact dermatitis in man and produces more allergic reactions than all other metals combined. Second in frequency is chromium.[6] The present study aimed to assess amount of nickel and chromium in saliva in patients with fixed orthodontic appliances.

We found that out of 20 patients, males were 8 and females were 12. Agaoglu et al[7] in their study found that the mean salivary nickel (Ni) content in

subjects with and without a fixed orthodontic appliance was 18.5 ± 13.1 and 11.9 ± 11.4 ng/ml, respectively. A statistically significant difference was found between the two groups. The mean salivary chromium (Cr) ion level recorded was 2.6 ± 1.6 ng/ml in the study group and 2.2 ± 1.6 ng/ml in the control group. The difference, however, was statistically insignificant.

We observed that pre- treatment value of nickel was 42.8 ppb, post- alignment was 58.6 ppb and after 12 months was 50.4 ppb. Pre- treatment value of chromium was 72.4 ppb, post- alignment was 94.6 ppb and after 12 months was 84.2 ppb.

Matos et al[8] found a statistically significant increase of 10.35 ppb in nickel ion concentration and 33.53 ppb in chromium ion concentration after initial alignment. The ionic concentration at the end of 10-12 months of treatment showed a statistically significant increase in of 17.92 ppb for chromium and a statistically insignificant decrease in nickel ion concentration by 1.58 ppb. Pearson's correlation coefficient showed a positive correlation for an increase in nickel concentration after aligning, but not at the end of 10-12 months. A positive correlation was seen for an increase in chromium ion concentration at both time intervals.

Petoumenou et al[9] in their study comprised of 45 orthodontic patients. The selected sample was divided into 3 groups. The first group consisted of 15 patients with fixed appliances in their upper & lower arches. The second group consisted of 15 patients with a fixed appliance placed only in the upper arch. The control group consisted of 15 patients who were not undergoing orthodontic treatment. Nickel and chromium release was quantified with the use of an atomic absorption spectrophotometr. The analysis of variance was used to determine if differences existed between the nickel and chromium release according to time interval. Four samples of stimulated saliva were collected from each patient before insertion of fixed appliance, 1 week, 1month, and 2 months after insertion of the appliance. A considerable variation in the concentrations of both nickel and chromium was observed. Significant differences were found between the no-appliance samples and the samples obtained after insertion of the appliance. Nickel and chromium concentrations of saliva are significantly affected by fixed orthodontic appliances during the first 2 month of treatment.

CONCLUSION

Author found that there was significant increase in nickel and chromium ion concentration in saliva of patients undergoing fixed orthodontics.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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