

## Original Research

### Nickel and chromium levels in the saliva of patients undergoing fixed orthodontic treatment

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#### ABSTRACT:

**Background:** To evaluate the nickel and chromium 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 18.5 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 and chromium content), 10 days after insertion of the appliance, and 6 months after insertion of the appliance. **Results:** Amount of salivary nickel and chromium at the baseline was 5.60 and 2.3 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 and chromium were 4.1 micro gram/L. **Conclusion:** The salivary nickel and chromium concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels.

**Keywords:** chromium, nickel, saliva.

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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. <sup>1</sup> 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. <sup>2</sup> 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. <sup>3,4</sup>

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. <sup>5</sup>

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, diarrhoea, and irritability. <sup>6,7</sup> Hence, this study is to evaluate the nickel and chromium 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 18.5 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 and chromium content), 10 days after insertion of the appliance, and 6 months after insertion of the appliance. These samples were analyzed for nickel and chromium 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 and chromium at the baseline was 5.60 and 2.3 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 and chromium were 4.1 micro gram/ L. After 6 months of orthodontic appliance placement, the nickel levels were decreased to 5.48 and chromium levels were 3.86 micro gram/L.

**Table: amount of salivary nickel and chromium (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	5.6	6.3	5.48	0.4
Chromium	2.3	4.1	3.86	0.18

**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.<sup>8,9</sup> To confirm the validity of the result of in-vitro studies, several in-vivo studies were carried out.<sup>10</sup> In this study, a total of 40 subjects were enrolled. Amount of salivary nickel and chromium at the baseline was 5.60 and 2.3 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.3 and chromium were 4.1 micro gram/ L.

A study by Yassaie 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.<sup>11</sup> In our study, after 6 months of orthodontic appliance placement, the nickel levels were decreased to 5.48 and chromium levels were 3.86 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.<sup>12</sup>

Kerousou et al. found that during the first month of treatment, fixed orthodontic appliances did not significantly affect Ni and Cr concentrations in saliva.<sup>13</sup> Barrett et al. concluded that the release rates of Ni and Cr from stainless-steel and NiTi arch wires were not significantly different.<sup>14</sup>

**CONCLUSION**

The salivary nickel and chromium 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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