

## Original Research

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

<sup>1</sup>Dr Tanvi Verma, <sup>2</sup>Dr. Jasmine Arneja

<sup>1</sup>MDS Orthodontics, Private Practitioner, India;

<sup>2</sup>MDS Orthodontics, Private Practitioner, USA

#### ABSTRACT:

**Background:** To assess the nickel and chromium levels in the saliva undergoing fixed orthodontic treatment. **Materials & methods:** A total of 50 subjects were enrolled. 35 were female and 15 were male with fixed orthodontic treatment. 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. Result was analysed using SPSS software. **Results:** A total of 50 subjects were enrolled. Amount of salivary nickel and chromium at the baseline was 5.2 and 2.7 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.60 and chromium were 3.8 micro gram/ L. **Conclusion:** The salivary nickel and chromium concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels.

**Keywords:** orthodontic treatment, saliva, nickel levels.

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**Corresponding Author:** Dr Tanvi Verma, MDS Orthodontics, Private Practitioner, India

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#### INTRODUCTION

Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented. <sup>1</sup> 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. <sup>2</sup> 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. <sup>3,4</sup> Stainless-steel alloys include 17% to 22% of chromium. <sup>5</sup> Fixed orthodontic treatment causes major changes in the composition of the saliva. <sup>6</sup> Nickel and chromium ions released from fixed orthodontic appliances can serve as allergens or may have serious biological side effects. <sup>2</sup> Moreover, they are cytotoxic, mutagenic, and carcinogenic in small quantities in the range of nanograms. <sup>2</sup> Evaluation of the level of trace elements in patients using orthodontic appliances is a priority. <sup>7</sup> Both nickel and chromium ions can cause hypersensitivity reactions in some people. <sup>8</sup> In

addition, nickel and chromium can cause dermatitis and asthma. <sup>9</sup> 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. <sup>8</sup>

Nickel-containing alloys exist in a wide variety of appliances and auxiliary devices used in orthodontics, with a content of up to 55% by weight. <sup>10</sup> Likewise, the in vivo release of nickel ions varies greatly from 0.5 to 105.7 µg/l, according to the alloy type, body fluid, temperature, mechanical stress, or pH. <sup>11</sup> In general, orthodontic materials are considered to be highly biocompatible. The systemic absorption of leached metal ions usually can be definitively measured using available biomarkers that include blood, hair, urine, saliva, and gingival crevicular fluid (GCF). <sup>12</sup> In vitro nickel release from orthodontic appliances was reported to be 22–40 µg/day, which was lower than the estimated dietary intake. <sup>13</sup> The inherent heterogeneity of metal alloys and their use in

combination with other alloys, microconversion, the forces acting on the appliances, and the friction between wires and brackets may further add to the corrosion process.<sup>14</sup> Therefore, in orthodontic practice, it is essential to know the exact amount of each ion released during the course of treatment, and inform the patient undergoing orthodontic treatment in this respect.<sup>2</sup> Hence, this study was conducted to assess the nickel and chromium levels in the saliva undergoing fixed orthodontic treatment.

## MATERIALS & METHODS

A total of 50 subjects were enrolled. 35 were female and 15 were male with fixed orthodontic treatment. 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 50 subjects were enrolled. Amount of salivary nickel and chromium at the baseline was 5.2 and 2.7 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.60 and chromium were 3.8 micro gram/ L. After 6 months of orthodontic appliance placement, the nickel levels were decreased to 5.37 and chromium levels were 3.92 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	5.2	6.60	5.37	0.3
Chromium	2.7	3.8	3.92	0.1

## DISCUSSION

Nickel and chromium ions discharged from fixed orthodontic appliances can act as allergens or may have serious biological adverse effects. Allergic reactions are the predominant side effects, owing to the unavoidable release of nickel ions as a by-product of intraoral corrosion.<sup>15</sup> This has caused concerns among orthodontic patients, their parents, and orthodontists, owing to the possible association of orthodontic treatment with the prevalence of nickel hypersensitivity.<sup>16</sup> However, previous in vitro and in vivo evidence indicates that oral nickel intake, especially prior to cutaneous sensitization, may favor the induction of oral tolerance to nickel.<sup>17</sup> Hence, this study was conducted to assess the nickel and chromium levels in the saliva undergoing fixed orthodontic treatment.

In the present study, a total of 50 subjects were enrolled. Amount of salivary nickel and chromium at the baseline was 5.2 and 2.7 respectively. There was slight increase in both the measurements after 10 days of orthodontic treatment and the levels of nickel were 6.60 and chromium were 3.8 micro gram/ L. A study by Yassaei S et al, studied 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. 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>18</sup>

In the present study, after 6 months of orthodontic appliance placement, the nickel levels were decreased to 5.37 and chromium levels were 3.92 micro gram/L. Another study by Pritam A et al, studied forty patients undergoing fixed orthodontic treatment and were divided into 2 groups of 20 each. In group I, there were 6 male and 14 female and in group II 7 males and 13 females. The mean nickel level (ng/ml) before treatment in group I was 0.49 and in group II was 0.52, on 7th day was 0.52 and 0.54, on 30th day was 13.4 and 100.2, and on 6th month was 0.54 and 0.52 in Group I and II, respectively. The mean chromium level (ng/ml) before treatment in Group I was 0.48 and in Group II was 0.52, on 7th day was 0.52 and 0.53, on 30th day was 40.6 and 62.4 and on 6th month was 4.9 and 0.52 in Group I and II, respectively. The difference was significant ( $P < 0.05$ ).<sup>19</sup>

Another study by Bhasin V et al, showed that at 1 month, the mean value of nickel and chromium in GCF was found to be 4.5 and 4.9 µg/gm of GCF respectively. They compared the mean nickel levels between 1 and 6 months and between baseline and 6 months, significant results were obtained. Significant results were also obtained while comparing the mean values of chromium in GCF between baseline and 6 months and between 1 and 6 months. Gingival health index of the patients was found to be associated with increased inflammation with the progression of time of orthodontic treatment.<sup>20</sup>

## CONCLUSION

The salivary nickel and chromium concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels.

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