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Original Research

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

Dr. Kishor B. Bagalkot[1], Dr. Harinarayan Dhaka[2], Dr. Jaskaran Singh[3], Dr. Sumit kalsi[4], Dr. Sanjeev Soni[5], Dr. Vishal Kumar Sharma[6]

[1]Consultant Orthodontist & Dental surgeon, Dr. Kishor B. Bagalkot Dental Orthodontic and Implant Centre, Karnataka , India;
[2]Assistant Professor, Rajasthan Dental college & Hospital, Jaipur, Rajasthan, India;
[3]Reader , [5]Professor and HOD , [6]Senior lecturer, Department of orthodontics and Dentofacial Orthopedics , Desh Bhagat Dental college and Hospital , Mandi Gobindgarh, Punjab, India;
[4]MDS Orthodontist Private practitioner, Special Dental Care, Jammu, India

ABSTRACT:
Background: Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented. Nickel has been systematically studied for detrimental effects at cell, tissue, organ, and organism levels. Hence; the present study was conducted for assessing the salivary nickel levels in patients undergoing fixed orthodontic treatment. **Materials & methods:** A total of 20 patients were enrolled. Complete demographic and clinical details of all the patients were obtained. Before the starting of the fixed orthodontic treatment, salivary samples were obtained from all the patients and salivary nickel levels were assessed using auto-analyzer. Similar samples were obtained from all the patients one month after starting of fixed orthodontic treatment and two months after starting of fixed orthodontic treatment. All the results obtained were tabulated and were subjected to statistical analysis. All the results were analyzed by SPSS software by employing student t test. **Results:** Mean salivary nickel levels during the pre-treatment time, One month after starting of treatment and Two months after starting of treatment was found to be 1.36 µg/L, 5.33 µg/L and 3.26 µg/L respectively. While analyzing statistically, it was observed that there was significant rise in serum nickel levels one month after starting of treatment followed by reduction after two months after starting of treatment. **Conclusion:** There is a transient rise in salivary nickel levels in patients undergoing fixed orthodontic treatment.
Key words: Nickel, Orthodontic, Salivary

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Corresponding author: Dr. Kishor B. Bagalkot, Consultant Orthodontist & Dental surgeon, Dr. Kishor B. Bagalkot Dental Orthodontic and Implant Centre, Karnataka , 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. 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. 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.[1-3]

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 mutating 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, diarrhea, and irritability.[4- 6]Hence; the present study was conducted for assessing the salivary nickel levels in patients undergoing fixed orthodontic treatment.

Materials & methods

The present study was conducted with the aim of assessing salivary nickel levels in patients undergoing fixed orthodontic treatment. A total of 20 patients were enrolled. Complete demographic and clinical details of all the patients were obtained. Cephlometric analysis was done in all the patients and primary impression was obtained. Diagnostic casts were made and treatment planned was done. Before the starting of the fixed orthodontic treatment, salivary samples were obtained from all the patients and salivary nickel levels were assessed using auto-analyzer. Similar samples were obtained from all the patients one month after starting of fixed orthodontic treatment and two months after starting of fixed orthodontic treatment. All the results obtained were tabulated and were subjected to statistical analysis. All the results were analyzed by SPSS software by employing student t test.

Results

A total of 20 patients were analyzed. Mean age of the patients was 13.1 years. 40 percent of the patients belonged to the age group of 12 to 15 years. There were 13 males and 7 females in the present study. Mean salivary nickel levels during the pre-treatment time, One month after starting of treatment and Two months after starting of treatment was found to be 1.36 µg/L, 5.33 µg/L and 3.26 µg/L respectively. While analyzing statistically, it was observed that there was significant rise in serum nickel levels one month after starting of treatment followed by reduction after two months after starting of treatment.

Graph 1: Age and gender-wise distribution

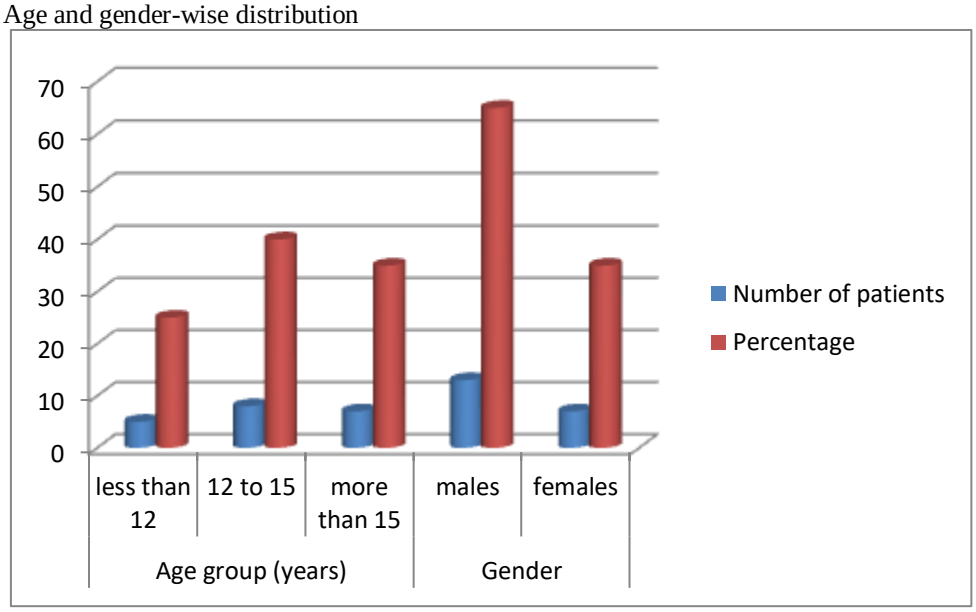

Table 1: Salivary nickel levels in between two study groups before and after the treatment

Salivary chromium levels (µg/L)	Pre-treatment	One month after starting of treatment	Two months after starting of treatment
Mean	1.36	5.33	3.26
SD	0.75	1.95	1.42

Table 2: Comparison of salivary nickel levels in between two study groups before and after the treatment

Comparison	t- value	p- value
Pre-treatment VS One month after starting of treatment	-1.226	0.001 (Significant)
One month after starting of treatment VS Two months after starting of treatment	-1.856	0.002 (Significant)
Pre-treatment VS Two months after starting of treatment	-1.645	0.001 (Significant)

Discussion

Although fixed appliances have revolutionized contemporary orthodontic treatment, they can at the same time be considered a risk factor to the integrity of tooth enamel due to plaque accumulation and their colonization by oral microbes. The placement of fixed orthodontic appliances complicates the use of standard oral hygiene procedures and causes alterations in the oral microflora by reducing pH, as well as by increasing plaque accumulation and the affinity of bacteria to metallic surfaces due to electrostatic reactions.[7-9]Hence; the present study was conducted for assessing the salivary nickel levels in patients undergoing fixed orthodontic treatment.

A total of 20 patients were analyzed. Mean age of the patients was 13.1 years. Mean salivary nickel levels during the pre-treatment time, One month after starting of treatment and Two months after starting of treatment was found to be 1.36 µg/L, 5.33 µg/L and 3.26 µg/L respectively. Singh DP et al examined whether orthodontic treatment induces an increase in salivary nickel and chromium concentration. Ten new patients (7 females and 3 males) beginning fixed orthodontic treatment were included in the study. The mean age of the sample was 17.5 years (range 14 to 24 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/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. This study 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.The salivary nickel and chromium concentrations significantly increased after insertion of fixed orthodontic appliances as compared to baseline levels, with the maximum concentration seen in the first week after placement of fixed orthodontic appliances.[10]

In the present study, while analyzing statistically, it was observed that there was significant rise in serum nickel levels one month after starting of treatment followed by reduction after two months after starting of treatment. Grimstottle and Pettersen suggested that negligible level of Ni and Cr was released from archwires. Though most of the orthodontic attachments are made of highly corrosion resistant metals and metal alloys but their electrochemical breakdown is observed in the oral environment, thereby contributing to the release of metal ions. The psychological stress can also alter the oral environment by decreasing the pH value, decreasing salivary flow and increasing the protein content of saliva. Nickel binds to salivary proteins, thereby influencing its concentration. The variation in the values of the present study from the other studies could be because of varying concentration of Ni and Cr ions in air, soil; food and water that the subjects were taking; and the type of utensils being used for cooking.[11]

G Ağaoğlu et al evaluated the concentrations of nickel and chromium ions in salivary and serum samples from patients treated with fixed orthodontic appliances. A second aim of this study was to determine any significant changes in these concentrations during any period of the treatment time. Saliva and blood samples were collected from 100 patients ranging in age from 12 to 33 years. Twenty samples from each group were obtained. The groups were as follows: In the first group, saliva and blood samples were collected before insertion of the fixed appliances. In the second, third, fourth, and fifth groups, samples were collected at 1 week, 1 month, 1 year, and 2 years after appliance insertion. The serum was prepared by centrifuging the blood samples at 3000 rpm for 10 minutes. The fixed appliances consisted of an average of 4 bands and 20 bonded brackets. No palatal or lingual appliances welded to bands or extraoral auxiliary appliances were used. In the serum, there were statistically significant increases in ion concentration in the second-year groups. In saliva samples, nickel and chromium reached their highest levels in the first month and decreased to their initial level in the rest of the groups.[12]

Conclusion

From the above results, the authors concluded that there is a transient rise in salivary nickel levels in patients undergoing fixed orthodontic treatment.

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