

How to Cite:

Yerawar, A., Jadhav, P., Kolekar, S., Salokhe, O., Baraskar, S. ., Khot, P., & Kolekar, S. (2022). Assessment of impact of fixed orthodontic treatment on salivary nickel levels. *International Journal of Health Sciences*, 6(S1), 9018–9022. <https://doi.org/10.53730/ijhs.v6nS1.7044>

Assessment of impact of fixed orthodontic treatment on salivary nickel levels

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Abstract---Background: The present study was conducted for assessing the impact of fixed orthodontic treatment on salivary nickel levels. Materials & methods: A total of 20 subjects who were scheduled to undergo fixed orthodontic treatment were enrolled in the present study. Complete demographic details of all the subjects were obtained. A Performa was made and complete clinical findings of all the subjects were recorded. At baseline (during the start of fixed orthodontic treatment), salivary samples were obtained and salivary nickel levels were evaluated using an autoanalyzer. Same procedure was repeated on regular follow-ups and salivary nickel levels were assessed. All the results were recorded in Microsoft excel sheet and were analyzed by SPSS software. Results: Mean salivary nickel levels at baseline, 6 months follow-up and 1 year follow-up was 8.9 µg/L,

11.3 µg/L and 8.5 µg/L respectively. Significant results were obtained while comparing the mean salivary nickel levels at different time intervals. Conclusion: It could be concluded that orthodontic therapy for longer durations with stainless-steel archwires might elevate slightly, but significantly, salivary nickel levels.

Keywords---Fixed Orthodontic, Nickel, Salivary.

Introduction

Nickel is a carcinogenic, cytotoxic, mutagenic, and allergenic trace element known to induce cancer, birth defects, and other reproductive harms. It is the most common source of contact allergy and is a major cause of asthma. Therefore, it has been investigated at DNA to organism levels, and its potential adverse effects have been publicized. It is a key component of nickel–titanium (NiTi) orthodontic appliances and one of the elements available in stainless steel (SS) ones, which respectively contain approximately 60 and 8 % nickel. These alloys are susceptible to corrosion and can release nickel ions into saliva through various mechanisms. Under in vitro conditions, orthodontic alloys can resist corrosion by the formation of a passivation layer.¹⁻³

The use of various combinations of metal alloys for prolonged durations in orthodontic patients warrants special consideration regarding their biocompatibility. The oral cavity is a complete corrosion cell, with many factors that enhance the biodegradation of orthodontic appliances.^{4, 5} A number of studies have investigated the release of metal ions from orthodontic alloys, but the results were not consistent. For example, while some authors have shown an increase in metal ion concentration in the oral fluid of patients with orthodontic appliances.⁶⁻⁸ Hence; the present study was conducted for assessing the impact of fixed orthodontic treatment on salivary nickel levels.

Materials & Methods

The present study was conducted for assessing the impact of fixed orthodontic treatment on salivary nickel levels. A total of 20 subjects who were scheduled to undergo fixed orthodontic treatment were enrolled in the present study. Complete demographic details of all the subjects were obtained. A Performa was made and complete clinical findings of all the subjects were recorded. At baseline (during the start of fixed orthodontic treatment), salivary samples were obtained and salivary nickel levels were evaluated using an autoanalyzer. Same procedure was repeated on regular follow-ups and salivary nickel levels were assessed. All the results were recorded in Microsoft excel sheet and were analyzed by SPSS software.

Results

Mean age of the subjects enrolled in the present study was 15.6 years. Out of 20 subjects, 12 were males while the remaining 8 were females. Mean salivary nickel levels at baseline, 6 months follow-up and 1 year follow-up was 8.9 µg/L, 11.3

$\mu\text{g/L}$ and $8.5 \mu\text{g/L}$ respectively. Significant results were obtained while comparing the mean salivary nickel levels at different time intervals.

Table 1
Comparison of salivary nickel levels at different time intervals

Time interval	Mean ($\mu\text{g/L}$)	SD	p- value
Baseline	8.9	1.2	0.012 (Significant)
6 months follow-up	11.3	1.8	
1 year follow-up	8.5	1.1	

Discussion

Nickel is a strong sensitizer and one of the most common causes of contact allergies. Patients and parents therefore may express concern about possible leakage of metal ions from an orthodontic appliance. In vitro release of nickel from orthodontic appliances has been noted using microscopic analysis of corrosion as well as chemical analyses of orthodontic components when exposed in an artificial oral environment.^{8- 11} Hence; the present study was conducted for assessing the impact of fixed orthodontic treatment on salivary nickel levels.

Mean age of the subjects enrolled in the present study was 15.6 years. Out of 20 subjects, 12 were males while the remaining 8 were females. Mean salivary nickel levels at baseline, 6 months follow-up and 1 year follow-up was $8.9 \mu\text{g/L}$, $11.3 \mu\text{g/L}$ and $8.5 \mu\text{g/L}$ respectively. Imani MM et al reviewed the effect of fixed orthodontic treatment on salivary levels of these ions by doing a meta-analysis on cross-sectional and cohort studies. The Web of Science, Scopus, Cochrane Library, and PubMed databases were searched for articles on salivary profile of nickel or chromium in patients under fixed orthodontic treatment published from January 1983 to October 2017. A random-effect meta-analysis was done using Review Manager 5.3 to calculate mean difference (MD) and 95% confidence interval (CI), and the quality of questionnaire was evaluated by the Newcastle–Ottawa scale. Fourteen studies were included and analyzed in this meta-analysis. Salivary nickel level was higher in periods of 10 min or less (MD = $-11.5 \mu\text{g/L}$, 95% CI = -16.92 to -6.07 ; $P < 0.0001$) and one day (MD = $-1.38 \mu\text{g/L}$, 95% CI = -1.97 to -0.80 ; $P < 0.00001$) after initiation of treatment compared to baseline (before the insertion of appliance). Salivary chromium level was higher in periods of one day (MD = $-6.25 \mu\text{g/L}$, 95% CI = -12.00 to -0.49 ; $P = 0.03$) and one week (MD = $-2.07 \mu\text{g/L}$, 95% CI = -3.88 to -0.26 ; $P = 0.03$) after the initiation of treatment compared to baseline. Corrosion of fixed orthodontic appliances leads to elevated salivary nickel and chromium concentrations early after initiation of orthodontic treatment.¹²

Significant results were obtained while comparing the mean salivary nickel levels at different time intervals. Yassaei S et al investigated the salivary concentration of nickel and chromium of patients undergoing orthodontic treatment. 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. The salivary samples were collected in a plastic tube and were stored in the freezer before analysis. The

samples were then transferred to the laboratory, and the amounts of metals were determined by graphite furnace atomic absorption spectrometry with an autosampler. Each sample was analyzed three times, and the average was reported. 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. There was no significant difference in the average amount of salivary nickel and chromium of patients at various stages of orthodontic appliance placement.¹³ Kaur N et al, in another study, assessed salivary nickel levels in patients undergoing orthodontic treatment. Materials and methods: They observed that mean nickel ions level before initiation of treatment was at 9.2 µg/L, after 6 months of treatment at 10.9 µg/L, and after 12 months at 8.6 µg/L. The level of nickel was comparable before the initiation of treatment and after 12 months.¹⁴

Conclusion

It could be concluded that orthodontic therapy for longer durations with stainless-steel archwires might elevate slightly, but significantly, salivary nickel levels.

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