ORIGINAL RESEARCH

Evaluation of Salivary nickel levels in patients undergoing orthodontic treatment

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ABSTRACT:
Background: Orthodontic appliances are highly biocompatible, although some side effects associated with the release of nickel ions have been documented. Nickel and chromium are trace minerals or micronutrients, and they play an important part in the overall health of the human body. Hence; the present study was conducted for evaluating the salivary nickel levels in patients undergoing orthodontic treatment. **Materials & methods:** A total of 25 patients who were scheduled to undergo fixed orthodontic treatment for different type of malocclusion were enrolled. Unstimulated salivary samples were obtained from all the patients on the day of starting of fixed orthodontic treatment and sent to laboratory for assessment of salivary nickel levels. Fixed orthodontic treatment was started in all the patients. Salivary samples were obtained one week after starting of the treatment, one month after starting of treatment and three months after starting of treatment. All the samples were sent to laboratory for assessment of salivary nickel levels. All the results were recorded and analysed using SPSS software. **Results:** Mean salivary nickel levels on the day of treatment were 1.352 μg/L. One week after starting of the treatment, one month after starting of treatment and three months after starting of treatment, the mean salivary nickel levels were found to be 6.112 μg/L, 3.299 μg/L and 2.368 μg/L respectively. Significant results were obtained while comparing the mean salivary nickel levels at different time intervals. **Conclusion:** There is transient rise in salivary nickel levels in patients undergoing fixed orthodontic treatment till a time period of one week, after which it starts declining over a period of time.
Key words: Orthodontic treatment, Nickel, Salivary

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. Stainless-steel alloys include 17% to 22% of chromium.[1-3]
Nickel and chromium are trace minerals or micronutrients, and they play an important part in the overall health of the human body. The average dietary intake of nickel is 200–300 μg/day. Nickel aids in iron absorption, as well as adrenaline and glucose metabolism. It also helps in improving bone strength and may play a role in the production of red blood cells. The primary route of eliminating nickel is through the urine. The dietary intake of chromium is 50–200 μg/day. The capacity of humans to absorb chromium is greatly influenced by the oxidation state of the chromium ion.[4-7] Hence; the present study was conducted for evaluating the Salivary nickel levels in patients undergoing orthodontic treatment.

MATERIALS & METHODS

The present research was carried out with the aim of assessing the effect of fixed orthodontic treatment on salivary nickel levels. A total of 25 patients who were scheduled to undergo fixed orthodontic treatment for

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different type of malocclusion were enrolled. Complete demographic data was obtained and clinical details were recorded in a reframed Performa. Unstimulated salivary samples were obtained from all the patients on the day of starting of fixed orthodontic treatment and sent to laboratory for assessment of salivary nickel levels. Fixed orthodontic treatment was started in all the patients. Salivary samples were obtained one week after starting of the treatment, one month after starting of treatment and three months after starting of treatment. All the samples were sent to laboratory for assessment of salivary nickel levels. All the results were recorded and analysed using SPSS software. ANOVA test was used for evaluation of level of significance.

RESULTS

A total of 25 patients were enrolled. Mean age of the patients was 19.4 years. 40 percent of the patients were males while the remaining were females. Mean BMI of the patients was found to be 23.4 Kg/m^2.

Mean salivary nickel levels on the day of treatment were 1.352 µg/L. One week after starting of the treatment, one month after starting of treatment and three months after starting of treatment, the mean salivary nickel levels were found to be 6.112 µg/L, 3.299 µg/L and 2.368 µg/L respectively. Significant results were obtained while comparing the mean salivary nickel levels at different time intervals.

Table 1: Demographic data

Variable	Value
Mean age (years)	19.4
Males (%)	60
Females (%)	40
Mean BMI (Kg/m^2)	23.4

Table 2: Comparison of salivary nickel levels at different time intervals

Time interval	Mean salivary nickel levels (µg/L)
On the day of treatment	1.352
One week after starting of treatment	6.112
One month after starting of treatment	3.299
Three months after starting of treatment	2.368
F-value	112.85
p- value	0.000 (Significant)

DISCUSSION

It is well known that oral cavity is an ecosystem which is known to cause biodegradation of metals which usually occurrs through the process of electrochemical breakdown. Besides, it is known that various orthodontic components such as nickel and chromium can cause hypersensitivity reactions in the oral cavity, cytotoxicity, and dermatitis. Furthermore, they might have significant mutagenic and possibly carcinogenic potential. Luckily, most of the orthodontic patients do not have visible reactions on the oral mucosa caused by orthodontic

materials, probably due to the influence of saliva.[8- 10] Hence; the present study was conducted for evaluating the Salivary nickel levels in patients undergoing orthodontic treatment.

In the present study, Mean salivary nickel levels on the day of treatment were 1.352 µg/L. One week after starting of the treatment, one month after starting of treatment and three months after starting of treatment, the mean salivary nickel levels were found to be 6.112 µg/L, 3.299 µg/L and 2.368 µg/L respectively. Amini F et al measured salivary levels of these ions during 1 year of orthodontic treatment. Saliva samples were collected from 20 orthodontic patients, before treatment (control) and 6 and 12 months later. Nickel and chromium concentrations were determined using atomic absorption spectrophotometry. Average nickel level changed from 9.75 ± 5.02 to 10.37 ± 6.94 and then to 8.32 ± 4.36 µg/L in 1 year. Average chromium concentration changed from 3.86 ± 1.34 to 4.6 ± 6.11 and then to 2.04 ± 1.66 µg/L. Alterations in nickel values were not statistically significant, but fluctuations in chromium levels were. The decrease in chromium concentration after 12 months was significant compared to the control. Although slightly increased after 6 months, the concentration of both ions dropped to levels slightly lower than the control groups after 12 months.[11]

In the present study, 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. In this study 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.[12]

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. Salivary nickel level was higher in periods of 10 min or less and one day after initiation of treatment compared to baseline (before the insertion of appliance). Salivary chromium level was higher in periods of one day and one week 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.[13] Staffolani

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et al reported that a daily release of Ni, Cu and Cr in vitro conditions in acid pH was lower than a daily dietary intake of these metals and that this findings support the use of orthodontic appliances by patients.[14]

CONCLUSION

From the above results, the authors concluded that there is transient rise in salivary nickel levels in patients undergoing fixed orthodontic treatment till a time period of one week, after which it starts declining over a period of time.

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