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Original Research

Assessment of salivary nickel levels among patients undergoing fixed orthodontic treatment

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ABSTRACT:

Background: This study aimed to evaluate salivary nickel concentrations in patients undergoing fixed orthodontic treatment.

Material and Methods: A total of 100 participants were enrolled and divided into two groups: Group 1 – 50 controls, and Group 2 – 50 subjects undergoing fixed orthodontic therapy. All participants were informed about the study and provided consent. Salivary nickel levels were measured in all subjects, and results were tabulated. Statistical analysis was performed using SPSS software.

Results: Mean salivary nickel concentration in controls was 0.97 mg/L. In the orthodontic treatment group, baseline levels were 5.9 mg/L, increasing to 6.3 mg/L after one month of treatment.

Conclusion: Salivary nickel concentrations were higher in patients undergoing fixed orthodontic treatment compared to controls.

Keywords: Nickel, Salivary, Orthodontic treatment

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INTRODUCTION

Orthodontic appliances are generally considered highly biocompatible; however, adverse effects related to the release of nickel ions have been documented. Fixed orthodontic components, such as brackets and archwires, are predominantly fabricated from stainless steel and nickel–titanium (NiTi) alloys, both susceptible to corrosion within the oral environment. Nickel content varies from approximately 8% in stainless steel to over 50% in NiTi alloys[1–4].

Stainless steel alloys also contain 17–22% chromium. Fixed orthodontic treatment has been shown to cause notable changes in salivary composition[5–8]. Nickel and chromium ions released from these appliances can act as allergens or produce significant biological effects, as they are recognized for their cytotoxic, mutagenic, and carcinogenic potential even in nanogram quantities. Monitoring trace element levels during orthodontic therapy is therefore critical. Both nickel and chromium ions are capable of inducing hypersensitivity reactions in susceptible individuals[9], and exposure may result in clinical manifestations such as dermatitis and asthma[10].

With the increasing prevalence of nickel hypersensitivity and the growing utilization of orthodontic treatment, research has intensified on the composition of orthodontic alloys and their ion release profiles during clinical use. The present study was undertaken to evaluate salivary nickel concentrations in patients receiving fixed orthodontic therapy.

MATERIAL AND METHODS

The primary objective of this study was to evaluate salivary nickel concentrations in individuals undergoing fixed orthodontic therapy. All participants were informed about the study protocol and provided consent. A total of 100 subjects were enrolled and divided into two groups of 50 each: Group 1 – controls and Group 2 – patients receiving fixed orthodontic treatment. Salivary nickel levels were measured in all participants at baseline and again after one month in the treatment group, with results tabulated and analyzed using SPSS software.

RESULTS

Table 1: Group-wise distribution of subjects.

Groups	Number of subjects	Percentage
Group 1 (control)	50	50
Group 2 (fixed orthodontic treatment)	50	50
Total	100	100

In this study, there were 50 controls in group 1 and 50 subjects in group 2 who underwent fixed orthodontic treatment.

Table 2: Salivary nickel levels in subjects of both groups

Groups	Salivary nickel levels
Group 1 (control)	0.97 mg/L
Group 2 (fixed orthodontic treatment)	
Baseline	5.9 mg/L
After 1 month	6.3 mg/L

In this study, mean salivary nickel concentration in the control group was 0.97 mg/L, while in the orthodontic treatment group it was 5.9 mg/L at baseline, increasing to 6.3 mg/L after one month of treatment.

DISCUSSION

In orthodontics, components of fixed appliances are fabricated from a variety of materials, each with specific physical and mechanical properties[11,12]. Stainless steel remains the most widely used material for wires, brackets, bands, buccal tubes, and auxiliary components because of its cost-effectiveness, high tensile strength, corrosion resistance, and biocompatibility. Depending on clinical needs, other wire types—such as nickel–titanium (Ni-Ti), beta titanium, cobalt–chromium, and Teflon polyethylene–coated wires—are also employed.

Corrosion of dental materials can occur due to multiple intraoral factors, including temperature fluctuations, pH changes, salivary composition, mechanical stresses, microbial and enzymatic activity, and the chemical nature of ingested food, as well as overall oral health status[13,14]. This process not only compromises the integrity of the appliance but also results in the leaching of nickel, chromium, iron, and other elements into the oral environment.

Nickel and chromium are trace micronutrients essential for human health. Average dietary nickel intake ranges from 200–300 μg/day. Nickel facilitates iron absorption, participates in adrenaline and glucose metabolism, contributes to bone strength, and may influence erythropoiesis. Its primary route of elimination is urinary excretion.

The present study assessed salivary nickel levels in patients undergoing fixed orthodontic treatment. Group 1 included 50 control participants, and Group 2 included 50 patients with fixed orthodontic appliances. Salivary nickel levels were 0.97 mg/L in controls, 5.9 mg/L in the orthodontic group at baseline, and 6.3 mg/L one month after appliance placement.

Kocadereli L et al.[15] evaluated changes in salivary nickel and chromium levels in 45 orthodontic patients over two months. Participants were divided into three groups: both arches treated, upper arch only, and untreated controls. Stimulated saliva was collected before appliance placement and at 1 week, 1 month, and 2 months. Analysis with electrothermal atomic absorption spectrophotometry showed large variations in ion concentrations, but no statistically significant differences between controls and post-treatment samples. The study concluded that fixed orthodontic appliances did not significantly alter nickel or chromium concentrations during the first two months.

Dwivedi A et al.[16] measured nickel and chromium levels in the saliva of 13 patients at baseline (Group I) and after 1 week (Group II), 1 month (Group III), and 3 months (Group IV) of fixed appliance therapy (including Ni-Ti and stainless steel components). Ion levels, measured using graphite furnace atomic absorption spectrophotometry, peaked at 1 week and then declined, with statistically significant differences between most time points ($p < 0.001$) except between 1 month and 3 months. All values remained below toxic thresholds, but caution was advised in nickel-hypersensitive individuals.

CONCLUSION

The findings of this study indicate that salivary nickel concentrations were elevated in individuals undergoing fixed orthodontic treatment compared to control subjects.

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