

Nickel Allergy in Orthodontic Patients. A Review

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Abstract

Allergic reactions raise the utmost concern to health care practitioners in all fields of expertise. Nickel allergy can be seen occasionally in orthodontic patients as nickel is a component of the majority of orthodontic alloys. The objective of this review was to discuss the prevalence of nickel hypersensitivity reactions, compare the nickel ion release during orthodontics treatment and possible alternative treatment options available for patients with a nickel allergy. Further prospective researches with large sample sizes are required to improve the quality of evidence.

Keywords: Nickel allergy; nickel sensitivity; dental alloys; orthodontics.

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INTRODUCTION

Allergic reactions raise the utmost concern to health care practitioners in all fields of expertise. Nickel allergy can be seen occasionally in orthodontic patients as nickel is a component of the majority of orthodontic alloys. Allergic reactions have been clinically implicated in causing root resorption and hypodontia. Nickel has been found as a biological sensitizer that may induce short and long-term sensitivity reactions. It has been investigated that the high content of Nickel was found in patients with orthodontic appliances compared to non-orthodontic patients. Nickel allergy induces Type IV delayed hypersensitivity reactions in orthodontic patients. Clinically Nickel allergy in orthodontic patients is often represented as gingivitis, gingival hyperplasia, lip desquamation, multiform erythema, burning sensation in the mouth, angular cheilitis and periodontitis. These allergic reactions are linked with an inflammatory response mediated by the corrosion of orthodontic appliances and consequently causes the release of Nickel ions. It is clinically manifested as Nickel Allergy Contact Stomatitis (NiACS). NiACS is often associated with the burning sensation which is a common frequent symptom. It may also cause slight erythema to shiny lesions with or without edema. Vesicles are rarely observed. In chronic cases, the affected mucosa appears hyperkeratotic to ulcerated. Period oral dermatitis and the orolingual paresthesia are rarely observed in NiACS.

Moreover, sensitivity to Nickel can be evaluated by sensitivity tests. However, a brief history

of previous Nickel allergy must be taken into consideration. Careful observation of allergy symptoms after the insertion of Nickel-containing orthodontic archwire can also predict the Nickel allergy in orthodontic patients [1, 2].

Moreover, Skin changes during the orthodontic treatment should be examined and verified by Dermatologist [3].

The objective of this review was to discuss the prevalence of nickel hypersensitivity reactions, compare the nickel ion release during orthodontics treatment and possible alternative treatment options available for patients with a nickel allergy.

Overview

The incidence of nickel hypersensitivity reaction is overestimated in the literature. A survey was conducted by Heidi M. Kerosua and Jon E. Dahlb to assess the adverse patient reactions during orthodontic treatment with fixed orthodontic appliances containing nickel and to investigate alternative options of using nickel-free devices in orthodontic patients in Finland and Norway. Results were revealed and 46% of the respondents (n 298) reported at least 1 adverse patient reactions during the last 5 years. More than half had implications on the orthodontic treatment. However, Finnish respondents observed significantly higher adverse patients reactions as compared to Norwegian colleagues. Nevertheless, in Finland, the adverse reactions were most frequently associated with headgear treatment. Nickel-containing fixed appliances in nickel-allergic patients were more common in

Finland (77%) than in Norway (65%). At least 1 adverse patient reaction was observed during the treatment by the dentists [4].

Risk Factors for Nickel Allergy

There are several determinant factors that might initiate an allergy response. A study was conducted to determine the prevalence of nickel hypersensitivity reaction prior, during, and after orthodontic treatment with conventional stainless steel brackets and wires and to classify the nickel hypersensitive patients. A total sample of 170 patients was randomly divided into three groups A (n 60), patients prior to orthodontic therapy; B (n 66), patients during orthodontic treatment, and C (n 44), patients who had undergone previous orthodontic therapy. Hence, a positive association found between nickel hypersensitivity and previous personal allergic history to metals (χ^2 5 34.88, p, 0.0001) including daily use of metal objects (χ^2 5 11.95, p, 0.0005). Moreover, no statistically significant difference was found in the prevalence of contact dermatitis among the three groups (χ^2 5 0.39, p 5 0.848). In conclusion, orthodontic therapy with conventional stainless steel appliances does not initiate a nickel hypersensitivity reaction [5].

Another study addressed the prevalence and risk factors for contact sensitization in the general adult population. 1236 adults (44.2% men and 55.8% of women) were randomly selected. Contact sensitivity to at least 1 out of 24 allergens was found in 35.4% of the women and in 14.8% of the men. The most common allergens were nickel (17.6%), cobalt (2.8%), thiomersal (1.9%), fragrance mix respectively (1.8 %). All other allergens were observed in 1.0% or less. In women, ear piercing was an important risk factor for nickel sensitization in women the prevalence of contact sensitivity was common in this general population, especially in women. Smoking and Atopic Dermatitis might be a risk factor for contact sensitization [6]. Moreover, a study has reported that contact allergy is influenced by socio-demographic parameters and plays a significant role in the general population [7].

On the other hand, a study was conducted to study to determine the incidence of hypersensitivity to orthodontic metals, patch tests were carried out prior and 2 months after the placement of orthodontic appliances in 38 patients (17 male, 21 females) respectively. Hence, statistically significant positive reactions were found for nickel sulfate (21.1%), potassium dichromate (21.1%), and manganese chloride (7.9%); However, reactions to nickel sulfate had the greatest intensity. No differences were observed apparently between the reactions prior to and after placement of the orthodontic appliances. No statistical difference was observed regarding sex for any evaluated patients. Moreover, a greater tendency to positivity to nickel sulfate was commonly seen among female patients and to potassium dichromate in male patients [8].

A study by Blanco-Dalmau et al. suggested that a standardized patch test must be performed on industrial workers or employees that are exposed to nickel frequently. Hence, nickel allergy could also be associated as an occupational hazard [9].

Evaluation of Nickel release during orthodontic treatment

An in vivo study was performed to evaluate the nickel and chromium ion release during fixed orthodontic treatment using inductively coupled plasma-mass spectrometer. Saliva samples from 30 orthodontic patients were collected prior to treatment, after alignment and after 10-12 months of appliance therapy. Results revealed that there was a statistically significant increase in the nickel (10.35 ppb) and chromium (33.53 ppb) ion concentration after the initial alignment phase. However, a statistically significant net increase of 17.92 ppb was found in salivary chromium ion concentration in contrary to a statistically insignificant decrease of 1.58 ppb in salivary nickel ion concentration at the end of 10-12 months of treatment. In conclusion, a positive correlation was observed in the initial increase in nickel ion concentration. Moreover, no correlation was found for the change in nickel ion concentration at the end of 10-12 months. Nevertheless, a positive correlation was seen for the increase in chromium ion concentration after the initial alignment phase and at the end of 10-12 months of orthodontic treatment [10].

A study was conducted to evaluate and compare the nickel release from stainless steel and nickel-titanium archwires in artificial saliva over a period of three months with the use of stimulated fixed orthodontic appliances. The amount of nickel released from the fixed appliances into the artificial saliva was measured after 1 day, 7 days, 1 month, 2 months and 3 months respectively. The highest amount of nickel was relatively released from nickel titanium archwires, however, the quantity of nickel released from both NiTi and stainless steel archwires were not significant. Moreover, the rate of nickel released was high within the first week and continued up to the first month after which the nickel content was found stable among all the test groups [11].

Another study revealed that Nickel release occurred after placement of the bands and brackets and after placement of the Ni-Ti archwires, associated with an increase of the nickel ion concentration in the patient's saliva. This effect decreased within 10 weeks [12].

Alternative Treatment Options

A study was conducted by Barrett Nordstroma et al. revealed that the Gummetal wire is nickel-free and can be used as an alternative initial archwire to NiTi wires in patients who have a nickel allergy [13].

TSME appliances could be an alternative treatment option for patients with allergy to resin and nickel. TSME appliances have excellent biocompatibility due to its ability to form superficial oxides, which prevent oxidation and thus ultimately corrosion. Hence, the non-allergic properties of titanium allow to propose it as an alternative in patients with a long-term history of allergic reactions to a niche. However several prospective types of research are required to be addressed in this field for improving the quality of evidence [14].

Several attempts have been done to investigate the biocompatibility of orthodontics dental alloys over the past 20 years but the results remain inconclusive. A study was conducted to compare the standard 3 M Unitek nickel-titanium (NiTi) and stainless steel archwires with locally available JJ orthodontics wires. There was a significant release of Nickel and Chromium observed in the test groups. Therefore, extensive and stringent clinical trials are required before certifying any product to be used in orthodontics [15].

CONCLUSION

Nickel allergy can occur during orthodontic treatment. However, Brief history and careful observation of clinical signs and symptoms are often required in allergy patient.

Patch tests can reduce the incidence of allergy reactions. However, alternative options of using nickel-free dental alloys can be another choice of treatment for the patient with a nickel allergy.

Further prospective researches with large sample sizes are required to improve the quality of evidence.

Conflict of Interest

The author has no conflict of interest.

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