Case Report

A Severe Reaction to Ni-Containing Orthodontic Appliances

Olga Elpis Kolokitha[a]; Evangelia Chatzistavrou[b]

ABSTRACT

Exposure to nickel-containing orthodontic appliances may cause intra- or extraoral allergic reactions. Nickel is the most typical antigen implicated in causing allergic contact dermatitis, which is a Type IV delayed hypersensitivity immune response. This report presents an unusual reaction to nickel during the orthodontic treatment of an adult female patient. The patient had no previous history of allergy and had been wearing fixed metal upper appliances while in orthodontic treatment to assist the eruption of her impacted teeth. The adverse hypersensitivity reactions appeared only after the surgical exposure and included severe signs of eczematic and urticarial reactions of the face with redness, irritation, itching, eczema, soreness, fissuring, and desquamation as well as intraoral diffuse red zones. Diagnostic patch testing performed by the allergist revealed sensitization to nickel (++++ score). Treatment was achieved with nickel-free appliances. (*Angle Orthod.* 2009;79:186–192.)

KEY WORDS: Allergic reaction; Nickel allergy; Nickel sensitivity; Allergic contact dermatitis; Orthodontic appliances

INTRODUCTION

In daily orthodontic practice, a variety of metallic alloys, such as stainless steel, cobalt-chromium, nickel-titanium and beta-titanium, are used, and the majority of these contain nickel.[1] The percentage of nickel in the appliances, auxiliaries, and utilities used in orthodontics ranges from 8% (as in stainless steel) to more than 50% (as in the nickel-titanium alloys).[2–4] Leaching of these metallic components may be a potential trigger to an allergic reaction.[5]

Nickel is a strong immunologic sensitizer and may result in contact hypersensitivity.[6] The hypersensitivity reaction to nickel is due to a direct relationship with the presence of this metal in the environment and may be caused by ingestion or direct contact with the skin and/or mucosa.[7] Nickel-induced contact dermatitis is a Type IV delayed hypersensitivity immune response occurring at least 24 hours after exposure.[8,9] The absorbed nickel binds to certain proteins and forms antigens that, in turn, when in contact with the T lymphocytes of the regional lymph nodes, result in the formation of activated specialized T-cells. These T-cells are capable of causing tissue damage once brought into the blood circulation by lymph vessels.[10] Tissue reactions may consist of intraoral diffuse red zones, blisters and ulcerations extending to the perioral area, and eczematic and urticarial reactions of the face or more distant skin areas.[10]

The purpose of this article is to report a severe reaction to nickel-containing orthodontic appliances in an adult female patient, which occurred after the surgical exposure of her impacted teeth.

CASE REPORT

Patient History

A 27-year-old woman with a medical-free history was referred to the orthodontic office by her dentist to assist the eruption of her impacted maxillary canines (13 and 23). No previous allergies of any nature were reported, and no orthodontic treatment had ever been provided to the patient in the past.

Diagnosis

The patient presented with an orthognathic facial type and a straight profile (Figure 1a). The intraoral examination and the study models revealed a Class I

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Figure 1. (a) Initial facial and (b) intraoral photographs.

malocclusion with minor rotations at her anterior maxillary and mandibular teeth (Figure 1b). The initial orthopantomogram demonstrated impactions of both maxillary canines with 23 more mesially inclined (Figure 2a). The occlusal radiograph taken at the time of the examination showed that both canines were labially positioned (Figure 2b).

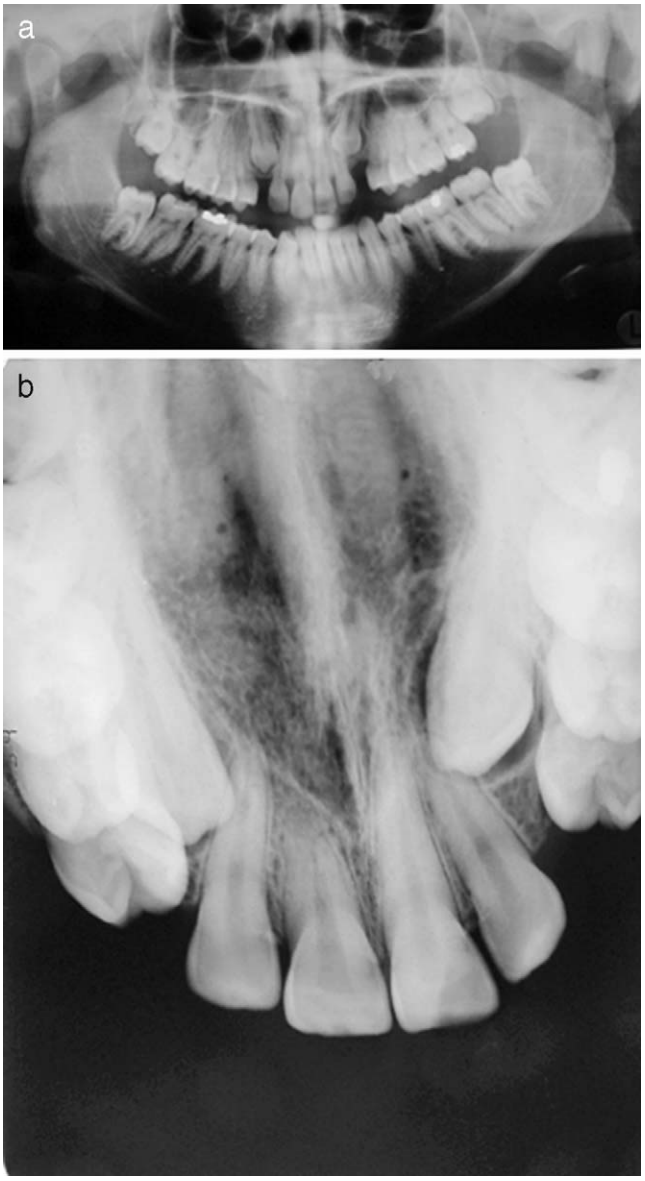

Figure 2. (a) Initial orthopantomogram and (b) occlusal radiographs.

Treatment Objectives

Based on the patient's chief complaint, the treatment objective was to surgically expose the impacted maxillary canines and use light forces to guide these teeth to occlusion.

Treatment Plan

The treatment plan consisted of orthodontic space opening and surgical exposure and traction of the maxillary impacted canines into proper position. Nonextraction orthodontic treatment with fixed appliances

was planned only for the maxillary dental arch. Retention was planned with a Hawley retainer.

Treatment Progress

Because no special esthetic concerns were expressed on behalf of the patient, standard metal edgewise appliances (0.022 × 0.028-in) were bonded in place and upper molar bands were fitted and cemented after the insertion of elastic separators. After leveling and alignment with 0.018 × 0.018 Bioforce Sentalloy archwires, (GAC, Bohemia, NY, USA), a nickel-titanium (NiTi) coil spring on a 0.018 × 0.025 NiTi archwire was applied at the sites of the absent 13 and 23 to provide the maximum possible space for the canines to erupt after their exposure. Four months after the initial bonding of the upper teeth, the patient was referred for surgical exposure of the impacted teeth.

A full-thickness mucoperiosteal flap was elevated to permit the bonding of metal buttons with steel ligature ties with fabricated bended loops. The flap was then fully replaced and totally covered the surgical field allowing only the loops of the ligature wires to project. Through these loops, the elastic traction of the impacted teeth was initiated. Four days after the surgical exposure, the patient reported the appearance of a rash on her face, but no connection was made at that time to any allergic reaction because the patient had already been in braces for 4 months without any signs of allergy.

The patient returned 15 days later presenting the typical signs of eczematic and urticarial reactions of the face: redness, irritation, itching, eczema, soreness, fissuring, and desquamation as well as intraoral diffuse red zones (Figure 3a,b). At that time, it was noted that the ligature tie attached to the bondable button of impacted maxillary right canine was missing. Immediately, the patient was referred to an allergist where, after the ordinary diagnostic patch testing, allergic contact dermatitis was confirmed with highly positive results on nickel (++++) and thiomersal (++). The facial allergic reactions improved shortly after removal of the attached button of the upper maxillary left canine (Figures 4a,b). The patient started treatment for the facial signs with the proper medicine as prescribed by a dermatologist, and all fixed appliances were removed until after her allergy signs and symptoms disappeared.

Seven months after her last appointment at the orthodontic office, the patient came back to resume treatment, with obvious signs of total healing of her previous face allergic reactions (Figure 5). Given the confirmed diagnosis of nickel allergy, the treatment planning was modified with the use of ceramic brackets and coated NiTi archwires for leveling and alignment (Figure 6).

Figure 3. (a) Facial photograph after surgical exposure of the canines presenting eczematic and urticarial allergic reactions. (b) Intraoral photograph after surgical exposure presenting intraoral diffuse red zones.

An open eruption technique was applied for the second surgical exposure of the maxillary canines. The crowns of the impacted teeth remained in full view at the end of surgery and bonding of the brackets was performed a week later in the orthodontic office (Figure 7). Once the maxillary canines were guided into occlu-

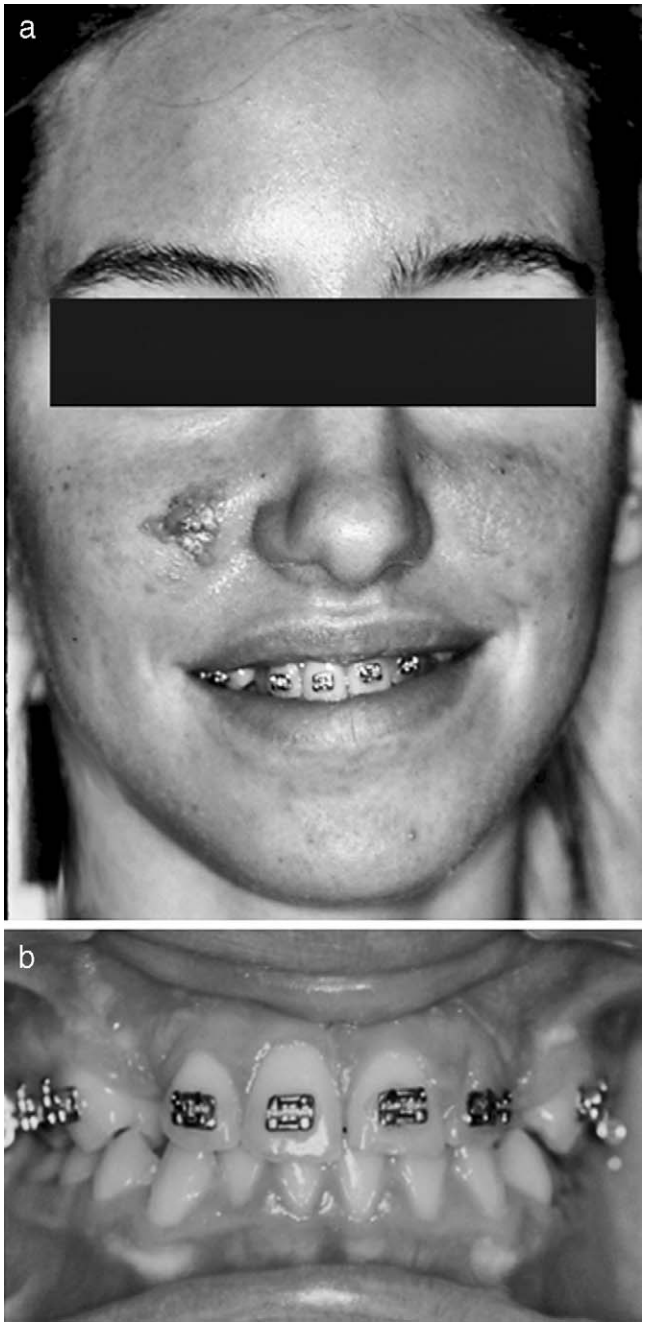

Figure 4. Improvement of (a) the facial and (b) intraoral allergic reaction after removal of the impacted canine button of 23.

sion, rectangular stainless steel wires were used for finishing and detailing. After about 3 years of total treatment, all fixed appliances were removed as the treatment goal had been achieved. The patient was satisfied with the result, and there were no signs of allergic reactions on her skin (Figures 8a,b).

Treatment Results

Despite the long treatment duration, the treatment goal was eventually achieved and the impacted canines were successfully aligned in the maxillary dental arch. The dental occlusion improved into the best possible situation. Finally, the allergic reactions induced by the nickel in the orthodontic appliances disappeared, and no signs of the previous tissue damage remained on the face of the patient.

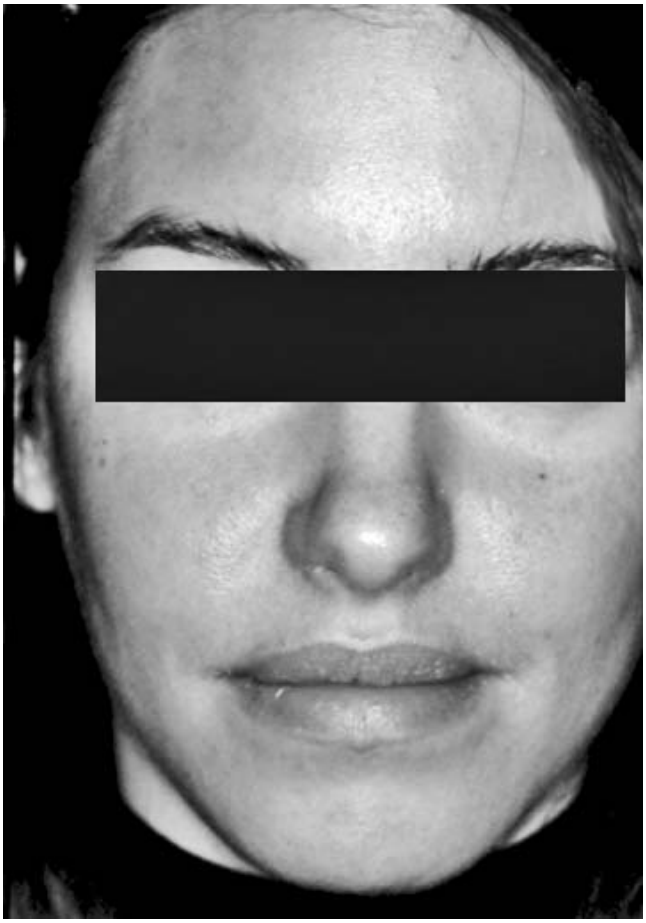

Figure 5. Total healing of facial allergic reaction.

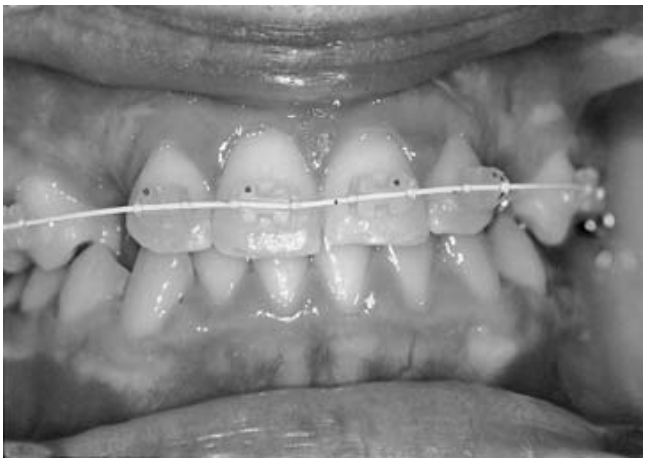

Figure 6. Modified treatment approach with ceramic brackets and coated archwires.

Figure 7. Bonding of ceramic canine brackets after the open window technique.

DISCUSSION

Nickel is known to be a common cause of contact allergies and hypersensitivity reactions.[11–13] It is estimated that 4.5% to 28.5% of the population have hypersensitivity to nickel.[11,14–16] Females have been reported to have a much higher prevalence than males, at 10 to 1.[11] In females, this hypersensitivity is thought to be related to environmental exposure (contact with detergents, jewelry, earrings, and other metallic objects such as wristwatches, metal buttons, and buckles). In males it is usually related more to occupational exposure (in industries that use nickel as a raw material).[7,14,17]

An injury to the skin from mechanical, physical, or chemical agents, followed by intimate contact with sensitizing allergens, favors the development of allergic eczematous dermatitis.[18] This immune response has two interrelated distinct phases: the sensitization phase, which occurs from the moment the allergen enters the body and is recognized, and the elicitation phase, which occurs after reexposure to the allergen and is characterized by the full clinical reaction. Even though there may have been no symptoms at the initial exposure, subsequent exposure leads to a more visible reaction.[19]

In this patient, the surgical exposure of the impacted teeth acted as an injury and the subsequent bonding of the metal buttons caused the contact with the sensitizing allergen. However, the hypersensitivity reactions were only expressed 4 days after the contact, when the allergen was circulated by the Langerhans cells to the regional lymph nodes in the facial area. Interestingly enough, no intraoral allergic signs or symptoms were reported before or even at the time of the extraoral reactions occurred.

Allergic contact dermatitis is most often confirmed through the use of the patch test procedure. In patch testing, small amounts of allergens are applied to the skin for a fixed time. The clinician then grades the patient's reaction to the allergens according to intensity and evaluates the reaction for clinical relevance.[20] When the patch-testing procedure was applied, this patient had a positive reaction to nickel (++++) and thiomersal (++), which are among the most prevalent allergens causing allergic contact dermatitis, based on both the thin-layer rapid use epicutaneous test data and the North American Contact Dermatitis Group data.[20] Thiomersal is a chemical substance used as a

Figure 8. Final (a) facial and (b) intraoral photographs.

preservative in certain cosmetics and in drugs such as ear and nose drops.

According to the International Research Contact Dermatitis Group guidelines, described in Menezes et al,[21] with regards to the reading of patch tests, a score of positive 4 (being the most severe of all reactions) is characterized by the presence of erythema, edema, papules, and vesicles at the testing area, whereas a score of positive 2 presents only an erythema, thus indicating a less intense allergic response to that allergen. Our patient had no previous history of allergies, and it is possible that the nickel content of the orthodontic attachments used at the surgical exposure of the upper impacted canines acted as the sensitizing allergen, and the allergen was diffused through the oral mucosa and distributed in the blood and lymph circulation provoking the hypersensitivity reactions reported.

Even though the presence of metal ions, such as nickel, has been associated with hypersensitivity reactions in orthodontics, there is only an indication that conversion to a nickel-positive reaction may be elicited by orthodontically derived nickel, particularly from nickel-containing extraoral appliances.[22] Recent reviews on this issue conclude that the risk is extremely low for patients who are not nickel hypersensitive at the start of the orthodontic treatment.[23,24] Because the clinical manifestations of nickel hypersensitivity are easy to diagnose, any intraoral or extraoral appliances containing nickel must be removed until after the dermal or mucosal signs of adverse reactions have healed completely.[4] For this reason, and because of the severity of the allergic response, we elected to remove the metal bondable canine buttons and all fixed appliances and wait for the total healing of the clinical manifestations before trying any alternative treatment approaches to assist the eruption of the impacted teeth.

A previous history of allergy should be considered a predictive factor of clinical manifestations of nickel hypersensitivity.[25] Alternative treatment modalities can be used so that the patients can benefit from the orthodontic treatment as originally planned. A known history of allergy to nickel could have prevented the initial orthodontic bonding with stainless steel (containing 8% nickel) brackets and the NiTi (containing in excess of 50%) archwires, as well as the use of metal bondable buttons with stainless steel ligatures at the time of the surgical exposure of the impacted canines. Instead, nickel-free brackets to stainless steel would have been used, such as ceramic (produced using polycrystalline alumina, single-crystal sapphire, and zirconia), polycarbonate (produced from plastic polymers), titanium, or gold-plated.[4,19]

With respect to the archwires, most research concludes that stainless steel is a safe material to use for all intraoral orthodontic components for nickel-sensitive patients because the crystal lattice of the alloys binds the nickel, thus preventing it from reacting.[26] In addition, archwires such as titanium molybdenum alloy and pure titanium could also be used without risk.[19] As for the impacted teeth, a gold chain with eyelet instead of a stainless steel bondable button could have been used as orthodontic attachment at the first attempt of exposure of the teeth. In this case, once the diagnosis of delayed hypersensitivity to nickel was confirmed, a combination of these treatment alternatives was applied.

In this case, the patient presented an allergic reaction to nickel-containing orthodontic brackets only after the surgical exposure of the impacted teeth, which acted as an injury; the bonding of the metal buttons caused the contact with the allergen. No signs of allergy were seen before surgical exposure, although the patient was in orthodontic treatment with metal brackets, bands, and NiTi archwires. The use of nickel-free brackets and archwires enabled us to achieve the treatment goal and the patient's satisfaction.

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