

A Delayed Hypersensitivity Reaction to a Stainless Steel Crown: A Case Report

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Stainless steel crowns are commonly used to restore primary or permanent teeth in pediatric restorative dentistry. Here, we describe a case of a delayed hypersensitivity reaction, which manifested itself as perioral skin eruptions, after restoring the decayed first permanent molar tooth of a 13-year-old Caucasian girl with a preformed stainless steel crown. The eruptions completely healed within one week after removal of the stainless steel crown. The decayed tooth was then restored with a bis-acryl crown and bridge. Since no perioral skin eruptions occurred during the six-month follow-up, we presume that the cause of the perioral skin eruptions was a delayed hypersensitivity reaction, which was triggered by the nickel in the stainless steel crown.

Keywords: stainless steel crown; delayed hypersensitivity; dental material hypersensitivity.
J Clin Pediatr Dent 36(3): 235–238, 2012

INTRODUCTION

Stainless steel crowns (SSCs) were first used in pediatric dentistry in 1950, and are now commonly used to restore primary or permanent teeth when there is decay on three or more tooth surfaces.^{1,2} The chemical composition of a preformed SSC is 65–73% iron, 17–20% chromium, 8–13% nickel, and less than 2% manganese, silicon, and carbon.³ Eliades and Athanasiou⁴ found that small amounts of the metals in an SSC can be released into the oral cavity, and the leached metals can potentially trigger an allergic reaction.⁵ Of these constituents, nickel is known to be a very common cause of contact allergy and hypersensitivity reactions.⁶ After its binding to protein, the leached nickel-protein complex can activate T cells, which, in turn, can mediate a non-immediate or delayed allergic reaction.^{7,8} Jacobsen *et al*⁹ reported that the frequency of an adverse reaction to dental biomaterials is about one *per* 2600 treated patients. It has also been reported that the frequency of such

reactions in patients, who are treated with a nickel-containing dental appliance, is between 0.3% and 0.4%, and that nickel-induced allergic reactions occur more frequently in women than in men.^{10–12} Furthermore, severity of these reactions can vary from mild to severe.^{10,11,13,14,15}

To the best of our knowledge, no immediate allergic or delayed hypersensitivity reactions to SSCs have yet been reported in the dental literature. In this report, we inform on a delayed hypersensitivity reaction to a preformed SSC, which was used to restore a decayed first permanent molar tooth of a young teenage girl.

Case Report

A 13-year-old Caucasian girl without any medical disorders, presented to the Department of Pedodontics, Faculty of Dentistry, Atatürk University, Turkey with a decayed right permanent maxillary first molar tooth. She had no body piercings, and did not wear earrings, a necklace, or a watch. She was not fitted with any dental appliances or an orthopedic prosthesis, an implantable cardiac device, or a permanent vascular cannula, and had no history of cardiac valve replacement surgery. She had no previous dental restorations that were made from a dental metal alloy (amalgam) or a polymer (resin-modified glass-ionomer cement (RMGIC), compomer, giomer, resin composite, and fissure sealant). In addition, she reported that she had not changed her tooth paste or skin cosmetic products within the last three months, and did not chew gum. She also reported no previous allergies of any nature, no history of an exanthematous disease, or had not used prescription or illegal drugs within the last three months.

The oral examination revealed that her left maxillary and mandibular permanent first molar teeth were missing because they had been extracted due to chronic infection.

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Since no other dental problems were found, it was decided that the decayed tooth would be restored with a preformed SSC (3M & ESPE, Seefeld, Germany). The SSC was first fitted, and then cemented with a luting GIC (Aqua Meron, Voco, Cuxhaven, Germany) by a pediatric research assistant. One week after its cementation, the patient consulted a dermatologist because of perioral skin eruptions, for which the dermatologist prescribed a topical corticosteroid and cicatrizing pomade. The dermatologist stopped the therapy after one week because she did not respond to the therapy. The dermatologist then did allergen patch skin testing of the patient, and she showed a positive reaction to nickel. From this result, the dermatologist concluded from the results that the probable underlying cause of the eruptions was the nickel in the preformed SSC that was used to restore the decayed tooth. The patient was then referred back to our clinic for removal of the SSC and tooth restoration using another biomaterial.

Clinical Evaluation

The clinical examination, which was done two weeks after cementation of the SSC, revealed skin vesicles, disseminated non-exudative rashes with an irregular border, and desquamation in the perioral region (Figure 1). The oral examination revealed no inflammation of her lips, oral mucosa, and gingivae, and there were no oral lichenoid lesions (Figure 2). There was moderate plaque accumulation [plaque index score (PI-S) = 1.4] and moderate gingivitis [gingivitis index (GI) = 1.6] (Figure 2). The pH of her saliva and her stimulated salivary flow rate were both normal [The pH range of healthy saliva is between 7.2-7.4, and the normal stimulated salivary flow rate is between 1 mL/minute and 1.6 mL/minute].

Under rubber dam isolation, the SSC was cut using a diamond fissure bur under water cooling, and then removed. During the removal of the SSC, care was taken to preserve the dental cement in order to ensure that it remained intact



Figure 1. Delayed hypersensitivity reaction on perioral area.

on the tooth surfaces (Figure 3). When she presented at the follow-up visit, one week later, the eruptions had completely healed, although she had not treated the eruptions over this one-week period (Figure 4). On this second visit, no tooth restoration program was begun because of moderate plaque accumulation and moderate gingivitis. The patient was given instructions to improve her oral hygiene, and asked to return to the clinic two weeks later.

When she returned two weeks later, a program to restore the decayed tooth with a temporary bis-acryl crown and dental bridge (Structure Premium, Voco, Cuxhaven, Germany) was initiated. Under local anesthesia, a silicone-based maxillary impression was made by the double impression technique. The dental cement was completely removed under water cooling to expose the hard dental tissues. A bis-acryl crown was then fabricated in accordance with the manufacturer's instructions, and then cemented onto the tooth remnant using a luting GIC. The occlusion of the replacement crown was then checked after removing the excess cement with a dental explorer and floss (Figure 5).



Figure 2. There was no hypersensitivity reaction around SSC, but plaque accumulation.



Figure 3. Intraoral view of cementation material on the tooth surfaces.



Figure 4. Total healing of perioral hypersensitivity reaction.



Figure 6. Perioral view of the patient after six months.



Figure 5. Modified treatment of the tooth using Structure Premium.



Figure 7. Intraoral view of the patient after six months.

She was re-examined in the clinic, one week later. The perioral facial eruptions did not recur after replacement of the SSC with the bis-acryl crown and dental bridge. She was asked to return six months later to the clinic for a follow-up examination. At the same time, she was asked to present herself immediately to the clinic should the eruptions recur. Over the six months, the eruptions did not reappear (Figure 6). When she presented herself for the 6-month follow-up examination, the extent of plaque deposition on the restored bis-acryl crown and the other teeth and the severity of the gingivitis were both modestly improved [PI-S = 1.1 and GI = 1.2]. The retention of the crown was tested by attempting to remove it by exerting moderate force with a dental spoon excavator, and examined for occlusal wear, denting, and perforation: the crown was still firmly in place and completely intact (Figure 7).

DISCUSSION

The nickel in dental appliances is known to be a very common cause of contact allergy and hypersensitivity reactions. Feasby *et al*¹⁶ studied nickel hypersensitivity in 5- to 12-year-old children who were fitted with a nickel-based dental appliance, such as a band-loop space maintainer, a lingual arch, or an appliance with stainless steel clasps and springs. They found that the overall incidence rate of positive patch test results in the study population was 8.1% (boys = 6.8%; girls = 9.5%).

SSCs are ranked fifth after amalgam, GICs, RMGICs, and composite resins in their use in pediatric restorative dentistry.¹⁷ In this case report, we describe a case of a delayed hypersensitivity reaction, which manifested itself as perioral skin eruptions, after restoring the decayed first permanent molar tooth of a 13-year-old Caucasian girl with a pre-formed SSC. The clinical signs of this reaction appeared one week after fitting the patient with an SSC, and the patient

became symptom-free when the SSC was removed. When the patient underwent allergen patch skin testing, she showed a positive reaction to nickel, and it was presumed that leached nickel from the preformed SSC was the probable cause of the perioral skin eruptions. We could not confirm that the nickel in the SSC was indeed the cause of the perioral skin eruptions because it would be unethical to re-expose the patient to the SSC.⁸ However, we are reasonably confident that the source of the nickel was the SSC because no other nickel sources could be identified from her medical and dental histories. We are also reasonably confident that the reaction was not due to other causes, such as a latex allergy, a previous exposure to another allergen before presenting to our clinic, or another dental compound because these causes as well as other allergens were eliminated when the patient underwent allergen patch skin testing.

It has been reported that hypersensitivity reactions which originate from orthodontic appliances appear more often on the skin than on the oral mucosa. This location bias probably occurs because the amount of leached nickel from the appliances is diluted in the saliva, thereby reducing the amount that comes in contact with the oral mucosa.^{11,12,18} A hypersensitivity reaction to stainless steel dental appliances could also be due to saliva-induced metal ion release from the appliance.¹⁹ Kutha *et al*¹⁹ reported on the effects of pH changes on the release of metal ions from orthodontic appliances, and found that their release at pH3.5 was several folds higher than that at pH6.75. The pH of normal saliva is between 6 and 7.4, and the pH of our patient's saliva was normal.²⁰ It has also been proposed that an increased salivary flow rate may reduce the exposure time of nickel ions on the oral mucosa.¹⁸ Her stimulated salivary flow rate was normal, and she had no intraoral lesions.

Contact sensitization comprises a sensitization phase and an elicitation phase. The sensitization phase involves the first exposure to and recognition of the allergen and its duration is about five days. Subsequent exposure to the allergen elicits a response that is mediated by activated allergen-specific T lymphocytes, and this elicitation phase generally occurs within one to two days following the first exposure to the allergen.⁷ The time course of the delayed hypersensitivity reaction in our patient is consistent with that described for contact sensitization: one week after cementation of the SSC, the patient consulted a dermatologist because of perioral skin eruptions. In our case, we think that sensitization occurred when the SSC was cemented, and the elicitation phase, the appearance of the perioral eruptions, occurred seven days after its cementation.

During the last four years, we have fitted 2900 SSCs on both primary and permanent molars in our dental pediatric clinic. This young teenage girl who was fitted with an SSC is the only patient who has re-presented to our clinic because of a hypersensitivity reaction. Since the nickel in the SSC was identified as the probable cause of the delayed hypersensitivity reaction, we removed the offending crown, and replaced it with one that was made from a bis-acryl dental

composite. No signs of an acute or delayed hypersensitivity reaction were seen in this patient during the six months after placement of the bis-acryl crown and dental bridge.

CONCLUSION

Hypersensitivity reactions to dental restorative treatments may occasionally occur, and when they occur, an alternative restorative material should be used.

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