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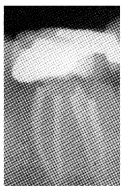

CASE REPORT

Root canal treatment on a patient with zinc oxide allergy: a case report

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Abstract

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Aim To describe successful root canal treatment of a patient with a true zinc oxide allergy and to discuss allergic reactions to dental materials.

Summary Dental materials have been reported as aetiologic agents for both local and systemic allergic reactions. It is essential for the oral healthcare provider to recognize the clinical symptoms associated with allergic reactions and to modify dental treatment, if necessary, to prevent these reactions from occurring. This article describes an unusual case of a patient with an allergy to zinc oxide. To our knowledge, this is the first case of successful root canal treatment of a patient with confirmed zinc oxide allergy to be reported in the dental literature.

Key learning points

• Medical and dental histories must be evaluated to prevent medical complications secondary to dental treatment.

• Any patient suspected of having an allergy to dental materials should be referred to a healthcare professional capable of performing and interpreting allergy tests prior to dental treatment.

Keywords: allergy, gutta-percha, root canal treatment, zinc oxide.

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Introduction

Allergic responses are becoming more prevalent in the general population and are contributing to escalating healthcare expenditures annually (Little *et al.* 2002). These allergies involve the humoral and/or cell-mediated branches of the immune system that are activated in response to a foreign substance (antigen). Many substances can induce allergic reactions, including environmental agents, foods, insect stings and drugs. Classic

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signs of allergic reactions include urticaria, swelling, rash and rhinorrhoea; however, a severe allergic reaction can be life threatening and may result in laryngeal oedema, bronchospasm and cardiac arrhythmias. Patients with a true allergy should be identified prior to initiation of dental treatment. It is critical for every oral healthcare provider to prevent allergic reactions from occurring, to recognize the signs and symptoms of acute allergic reactions, and be able to manage these situations appropriately.

The ideal dental material should be inert; however, most materials often have complex chemical properties that may precipitate allergic reactions. Both humoral and cell-mediated immune reactions have been reported to result from various dental materials and products (Braun *et al.* 2003). Fortunately, most allergic reactions associated with dental materials are localized reactions (contact allergy) and removal of the material reverses the localized symptoms. Rarely, the allergic reaction induced by these agents may be so severe as to cause anaphylactic shock, requiring immediate medical treatment and hospitalization of the patient (De Rossi & Greenberg 1998).

A number of dental materials have been implicated in the aetiology of intraoral contact allergy, including metals and restorative materials (Ozcelik & Haytac 2006). With an estimated prevalence ranging between 7% and 17%, nickel is the most common metal allergen in the USA, although the incidence of allergy induced by nickel-containing dental alloys is low (Wiltshire *et al.* 1996, Mark & Slavin 2006). Allergic reactions to nickel-containing dental materials have manifested as a rapid loss of alveolar bone that may compromise the integrity of the periodontium (Lamster *et al.* 1987, Bruce & Hall 1995). Amalgam restorations have been linked to intraoral contact allergy; the most common manifestation is a lichenoid reaction of the mucosal tissue at the site of direct contact with the restoration (Barkin *et al.* 1984). Other metals that have been implicated as a cause of contact allergy include gold, cobalt and chromium (Ozcelik & Haytac 2006).

Eugenol, usually combined with zinc oxide, is widely used in dentistry and is found in cements, root canal sealers, dry socket medicaments and periodontal dressings and has been reported as both a contact irritant and aetiologic agent of contact allergy. The setting reaction between zinc oxide and eugenol produces zinc eugenolate, which is highly unstable in the presence of water (Sarrami *et al.* 2002). The surface of this material undergoes hydrolysis, releasing free eugenol, which has been reported to induce both type IV hypersensitivity reactions as well as generalized anaphylactic symptoms (Hensten-Pettersen 1998, Sarrami *et al.* 2002, Silvestre *et al.* 2005). Formaldehyde, contained in disinfectants and sealers often used in endodontic procedures, has been reported to cause urticaria and anaphylaxis (Kunisada *et al.* 2002, Braun *et al.* 2003).

This case report describes root canal treatment on a patient with a true zinc oxide allergy. Most dental materials commonly used in endodontics contain zinc oxide and it was necessary to alter the provision of standard root canal treatment due to the patient's allergy to this substance. In general, a true allergy to zinc oxide is rare and to our knowledge, successful root canal treatment on a patient with this disorder has not been reported previously in the dental literature.

Case report

A 52-year-old Caucasian woman was referred to the Endodontic clinic at the University of Pennsylvania School of Dental Medicine, USA, with the chief complaint of 'my tooth is broken and my dentist referred me for endodontic treatment'. The dental history revealed that an amalgam restoration placed in tooth 17 (FDI) had fractured and the general dentist provided emergency endodontic treatment. The tooth was sealed with composite filling material. The patient was asymptomatic following the emergency procedure. Upon review of the medical history, the patient denied any systemic diseases and denied taking any

medications. She reported allergies to penicillin, codeine, potassium dichromate and zinc oxide. The patient indicated that as a child, she had developed an allergic reaction to BAND-AID® (Johnson and Johnson Consumer Companies Inc., Skillman, NJ, USA), then subsequently to cosmetics and cosmetic powder. She reported that allergic reactions initially appeared locally as dry spots, measuring 2–7 cm in diameter, and that within 48 h, the palms of her hands and soles of her feet became itchy. Although she was never formally evaluated for allergy to zinc oxide, she assumed that she was allergic to this compound based upon previous reactions to products containing zinc oxide. The patient's past dental history also revealed that she had developed a similar allergic reaction to a periodontal dressing placed after periodontal surgery. She reported that her gingiva had peeled off after the dressing was placed and that her tissues returned to normal after the dressing was removed.

Following clinical and radiographic examination, a diagnosis of apical periodontitis was made (Fig. 1). Root canal treatment was advised for tooth 17 and the patient agreed to the treatment. Allergy testing to confirm reactivity to zinc oxide prior to treatment was recommended because the dental materials to be used for her procedure contained zinc oxide. She was referred to the University of Pennsylvania Medical Center for patch testing to several dental materials, including zinc oxide. Initial evaluation of the patch test showed positive reaction to fragrance and potassium dichromate only. Two days after the initial evaluation, the patient reported back to the hospital with a delayed allergic reaction to zinc oxide at the patch test site, as well as on her hands and feet. Due to the delayed reaction, the patient's physician recommended avoiding dental materials containing zinc oxide.

On her second visit, the patient was informed that the root canal filling material gutta-percha contained zinc oxide, and was advised on other dental materials and technique to be used in her treatment. The patient nonetheless consented to the procedure and treatment was initiated. Four canals were located and the working length was established with a Root ZX (J. Morita USA, Inc. Irvine, CA, USA) electronic apex locator and working length file radiographs. The canals were instrumented with ProFile Series 29 rotary instruments (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) at the working length and irrigated with full strength sodium hypochlorite (5.2%) (Clorox® Bleach; The Clorox Company, Oakland, CA, USA) after each file. After biomechanical instrumentation, canals were dried and medicated with nonsetting calcium hydroxide (Calcium Hydroxide Powder, Henry Schein, Inc., Melville, NY, USA). Temporary restoration with glass–ionomer restorative material (Ketac-Molar Quick Aplicap; 3M ESPE, St Paul, MN, USA) was placed to seal the access opening. At the third visit, the canals were irrigated with sodium

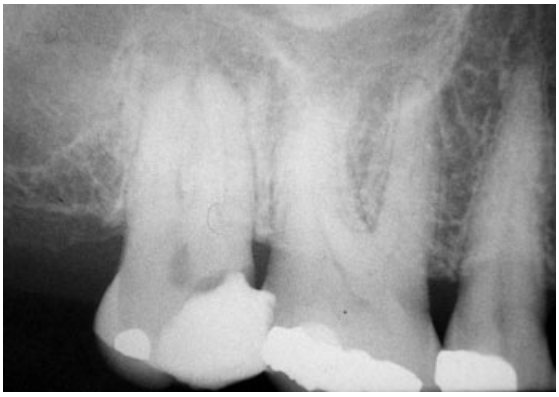

Figure 1 Tooth 17 (FDI) pre-operative radiograph.

hypochlorite and dried with paper points. Canal walls were filed with H-files to create dentinal chips. Dentinal chips were packed apically to create an apical plug in the apical 1.5 mm to establish a barrier between the gutta-percha and the periapical tissues. The canals were obturated using lateral compaction with gutta-percha and AH Plus [resin-based] sealer (Dentsply DeTrey, Konstanz, Germany) 1.5 mm shorter than the previously established working length. The access was sealed with glass–ionomer temporary material (Ketac-Molar Quick Aplicap; 3M ESPE) and the patient was referred back to her general dentist for the permanent restoration (Fig. 2). Follow-up telephone calls were made 24 h and 1 week after the treatment had been completed. The patient did not experience any symptoms of pain or allergic reaction. Sixteen months later, the patient was contacted for a follow-up appointment, at which time she reported that she could function normally and had no symptoms associated with the tooth. The tooth was restored with a permanent full metal crown and upon subsequent examination, was asymptomatic to percussion and palpation tests. The radiographic examination revealed periradicular healing and no evidence of pathology (Fig. 3).

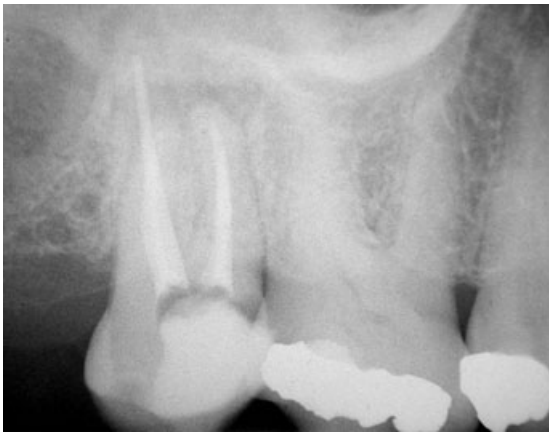

Figure 2 Post-operative radiograph.

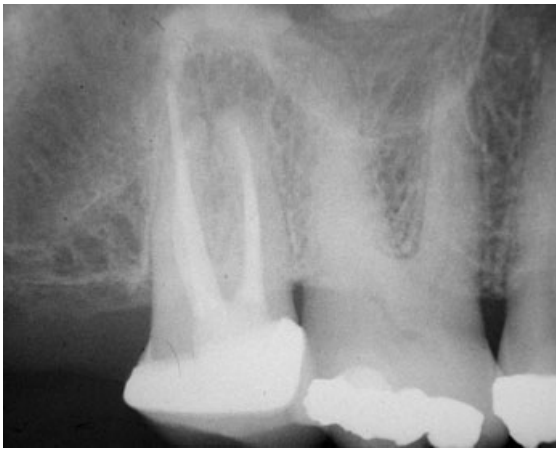

Figure 3 Sixteen months follow-up radiograph showing periapical healing.

Discussion

Contact allergy involving oral tissues is generally a T-cell-mediated (type IV) hypersensitivity reaction (Mallo Perez & Diaz Donado 2003). Haptens (incomplete antigens of low molecular weight) are usually responsible for the induction of intraoral contact sensitivity (Wiltshire *et al.* 1996). Haptens bind to mucosal proteins to form a complete antigen and are presented to T lymphocytes in regional lymph nodes (Barkin *et al.* 1984). Cytokine production is stimulated during this process and induces clonal proliferation and migration of T lymphocytes, thus sensitizing the individual to a subsequent re-exposure to a particular antigen (Mallo Perez & Diaz Donado 2003). When the antigen is re-introduced to the sensitized host, the immunologic cascade is initiated and the inflammatory response usually develops within 24–48 h.

Clinical manifestations of intraoral contact allergy can have various presentations due to the specific aetiologic factor and host response. Common findings include burning, erythema and oedema that usually manifest at the area of contact with the allergen, but may be seen elsewhere on oral mucosal tissues (Wiltshire *et al.* 1996). Activation of the immune system has been reported to induce pathological bone resorption and has been implicated in the development of periodontal disease (Rho *et al.* 2004, Takayanagi 2005). Severe allergic reactions may induce vesicle formation with subsequent ulceration and sloughing of oral epithelium, which can be extremely painful and potentially create a nidus for a secondary infection (Mallo Perez & Diaz Donado 2003). Lichenoid lesions may appear clinically as reticular, plaque-like or erosive lesions (Belsito 2004). Plasma cell gingivitis, characterized by generalized erythema and oedema of the attached gingiva and occasionally accompanied by cheilitis and glossitis, is another potential manifestation of intraoral contact allergy (Barkin *et al.* 1984). However, clinically a true contact allergy could be difficult to distinguish from chronic physical irritation, which is much more commonly observed than contact allergic reactions. Diagnosis of contact allergy is strengthened by temporally relating the onset of symptoms to exposure to the suspected allergen.

A patch test should be performed to diagnose a true contact allergy and any patient suspected of having a contact allergy should be referred to a healthcare professional capable of performing and interpreting these tests. The Thin-Layer Rapid-Use Epicutaneous Test (TRUE Test™; Mekos Laboratories A/S, Hillerod, Denmark) panels utilize 24 patches (23 allergens and one negative control) and is frequently used to test for dermatologic contact allergies (Suneja & Belsito 2001). The patient returns to the physician's office 48–72 h after initial application of the patch for removal and the host response to each allergen is graded according to presence and severity of clinical signs at each test site. Patients with equivocal reactions may return for a third visit 24–96 h later to determine if a more definitive reaction has occurred at the test site (Mark & Slavin 2006). Dental materials are commonly tested via small aluminium or plastic chambers (Finn chambers) containing allergens affixed to the skin with a hypoallergenic adhesive film (Wiltshire *et al.* 1996). Common compounds tested in a dental series include methacrylate monomers, eugenol, nickel sulphate, copper sulphate and formaldehyde (Ozcelik & Haytac 2006).

Treatment of intraoral contact allergy generally consists of discontinuing the offending product or removing the dental material that has been either suspected or confirmed as the causative agent (Barkin *et al.* 1984). Localized symptoms of intraoral contact allergy may be managed by topical corticosteroids, whilst patients with generalized symptoms of allergy should be referred to a physician for evaluation and management (Mallo Perez & Diaz Donado 2003).

Zinc oxide is commonly found in household products, cosmetics and several dental materials. Zinc oxide is a mild astringent with weak antiseptic properties and is commonly

used in ointments to promote healing of mild skin irritations and abrasions (Wynn *et al.* 2006). Allergy to zinc oxide is uncommon; it is considered nonirritant and is commonly added to some products to inhibit allergic reactions (Gafvert & Farm 1995). In the present case, the patient was aware of her previous reactions to products containing zinc oxide and was concerned with the materials used for her endodontic treatment. Her zinc oxide allergy was confirmed after patch testing; however, the patient's input was essential in diagnosing her allergy and modifying the root canal treatment. Immediate post-operative communications with the patient revealed that she did not experience any type of allergic reaction after treatment. Healing periapical tissues were evident in follow-up radiographs and the tooth being asymptomatic confirmed that the filling materials and the technique used for this procedure did not cause any allergic reaction and created an environment for successful root canal treatment.

During the root canal treatment, materials containing zinc oxide were avoided. A glass–ionomer-type filling material was used as a temporary filling material to seal the access. Commercially available gutta-percha root canal filling material contains approximately 19–22% gutta-percha and 59–79% zinc oxide (Himel & Goodis 2006). Munaco *et al.* (1978) and Pascon & Spangberg (1990) reported that gutta-percha is considered biocompatible with a low degree of toxicity; however, they noted that the high content of zinc oxide contributed to the toxicity of commercial gutta-percha. The patient had not been patch tested directly to gutta-percha, and possible reaction to zinc oxide within gutta-percha was unknown. The patient's past history revealed that her allergic reactions to zinc oxide were not only confined to the contact area, but also occurred in a distant area (i.e. hands and feet). This unusual remote allergic reaction to zinc oxide caused concern about using this material. In addition, bone resorption secondary to activation of the immune system could have possibly compromised the integrity of the periodontium. Thus, to prevent direct contact of zinc oxide with the apical tissues, an attempt was made to seal the apical terminus of each canal with dentinal chips and the gutta-percha filling was kept intentionally short of the determined working length. To further isolate gutta-percha cones, a resin-based root canal sealer was used to coat the canal walls and the cones.

Apical dentine plugs have been previously suggested to create a biocompatible barrier between the filling material and the periapical tissues (Tronstad 1978). Histological studies revealed that carefully packed noninfected dentine chips induce a favourable tissue response and hard tissue formation in the periapical areas. However, some studies pointed out that in necrotic pulps, dentine chips might contain bacteria and cause an unfavourable response (ElDeeb *et al.* 1983). Thus, in the present case, extra emphasis was placed on careful irrigation with full strength sodium hypochlorite and on intracanal medicament $Ca(OH)_2$ placement to achieve bacteria-free dentine chips.

Mineral Trioxide Aggregate (MTA) (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) has become a widely used material for several dental procedures, i.e. perforation repair, root-end filling. MTA may also be used as an apical barrier to prevent over-fillings and to promote apical healing in teeth with open apices (Maroto *et al.* 2003). Several *ex vivo* and *in vivo* studies have reported that MTA has superior physical properties (sealing properties) and greater healing induction potential when compared to other filling materials (Pitt Ford *et al.* 1996, Camilleri & Pitt Ford 2006). In the present case, MTA was considered for use as an apical matrix and/or a root filling material. However, this was impractical due to the limited access to tooth 17 and difficulties in manipulating MTA within the canals.

In recent years, a resin-based filling material (Resilon, Pentron Clinical Technologies, Wallingford, CT, USA) has been introduced as alternative to gutta-percha. It is composed of polyester, difunctional methacrylate resin, bioactive glass, radioactive glass and a resin sealer. Long-term success of this material has yet to be determined; however, studies

have shown that resilon is biocompatible and nontoxic (Himel & Goodis 2006). Resilon could be a good alternative to use with patients allergic to eugenol or zinc oxide-based dental materials. When the reported root canal treatment was performed, this material was not commercially available.

Conclusion

To our knowledge, this is the first case report of successful root canal treatment on a patient with a true zinc oxide allergy to be reported in the dental literature. Oral healthcare providers should understand the importance of reviewing a patient's medical and dental history prior to treatment and must be able to recognize the symptoms of intraoral and systemic allergies.

Disclaimer

Whilst this article has been subjected to Editorial review, the opinions expressed, unless specifically indicated, are those of the author. The views expressed do not necessarily represent best practice, or the views of the IEJ Editorial Board, or of its affiliated Specialist Societies.

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