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Allergy to acrylate in composite in an orthodontic patient: a case report

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ABSTRACT

Acrylate allergies have been reported in dental professionals as a result of repeat exposure to various acrylate monomers and in dental patients with removable prostheses or longstanding composite restorations. To date, there is only one report of an allergic reaction in a young patient from small volumes of resin-based orthodontic adhesive. This case report demonstrates a recent case of gingival inflammation and lip oedema attributed to an acrylate allergy arising from the composite adhesive used with fixed appliances. The impact on orthodontic treatment is reported and the wider implications for dentistry are discussed.

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Acrylate allergy; contact dermatitis; lip swelling; gingival inflammation; composite adhesive; orthodontics; Minamata Treaty

Introduction

Hypersensitivity reactions occur as a result of immune reaction to innocuous antigens. Type I reactions arise in genetically predisposed individuals following internalisation of an allergen, resulting in an immediate immunoglobulin E-mediated release of histamine and other immunological mediators. In dentistry, Type I reactions are most commonly associated with latex and nickel. Type IV reactions are mediated by T-cells and present as a delayed reaction, typically 48–72 hours after antigen exposure (Wiltshire and Noble 2007). Latex is the most common cause of Type IV hypersensitivity reactions but the number of reports of acrylate allergy in dental personnel is increasing (Syed et al. 2015). The most common presentation in dental professionals is contact dermatitis resulting from direct contact with various uncured monomers (Aalto-Korte et al. 2007). This can cause itching, burning, scaling and blistering confined to the areas of contact (Prasad Hunasehally et al. 2012).

Acrylate allergies have been reported in dental professionals as a result of repeat exposure to various acrylate monomers and in dental patients with removable prostheses or longstanding composite restorations. To date, only one patient case report exists that demonstrates an allergic reaction from small volumes of resin-based orthodontic adhesive (Hutchinson 1994). In this case, a 14-year-old male showed a reaction to a composite bonding agent (Unite), specifically the set composite and the catalyst paste. Our case report demonstrates acrylate allergy occurring in an orthodontic patient from the composite adhesive used with fixed appliances. The impact on orthodontic treatment is reported and the wider implications for dentistry are discussed.

Case report

History

An 11-year-old female patient (SW) was referred for orthodontic treatment to correct maxillary canine ectopia. SW was medically fit with no known allergies.

Extra and intra-oral assessment

SW had a Class I skeletal pattern with average vertical and transverse proportions. Examination revealed a class I occlusion with mild malalignment, diminutive maxillary lateral incisors and unerupted maxillary canine teeth with retained primary canines (Figure 1).

Radiographic assessment

The Dental Panoramic Tomograph (DPT) revealed the presence of the full adult dentition including third molars. No pathology was noted. The maxillary right primary canine tooth showed significant resorption and the maxillary right permanent canine (UR3) was close to eruption. The maxillary left permanent canine (UL3) was palatally ectopic, angled at 45° to the midline with

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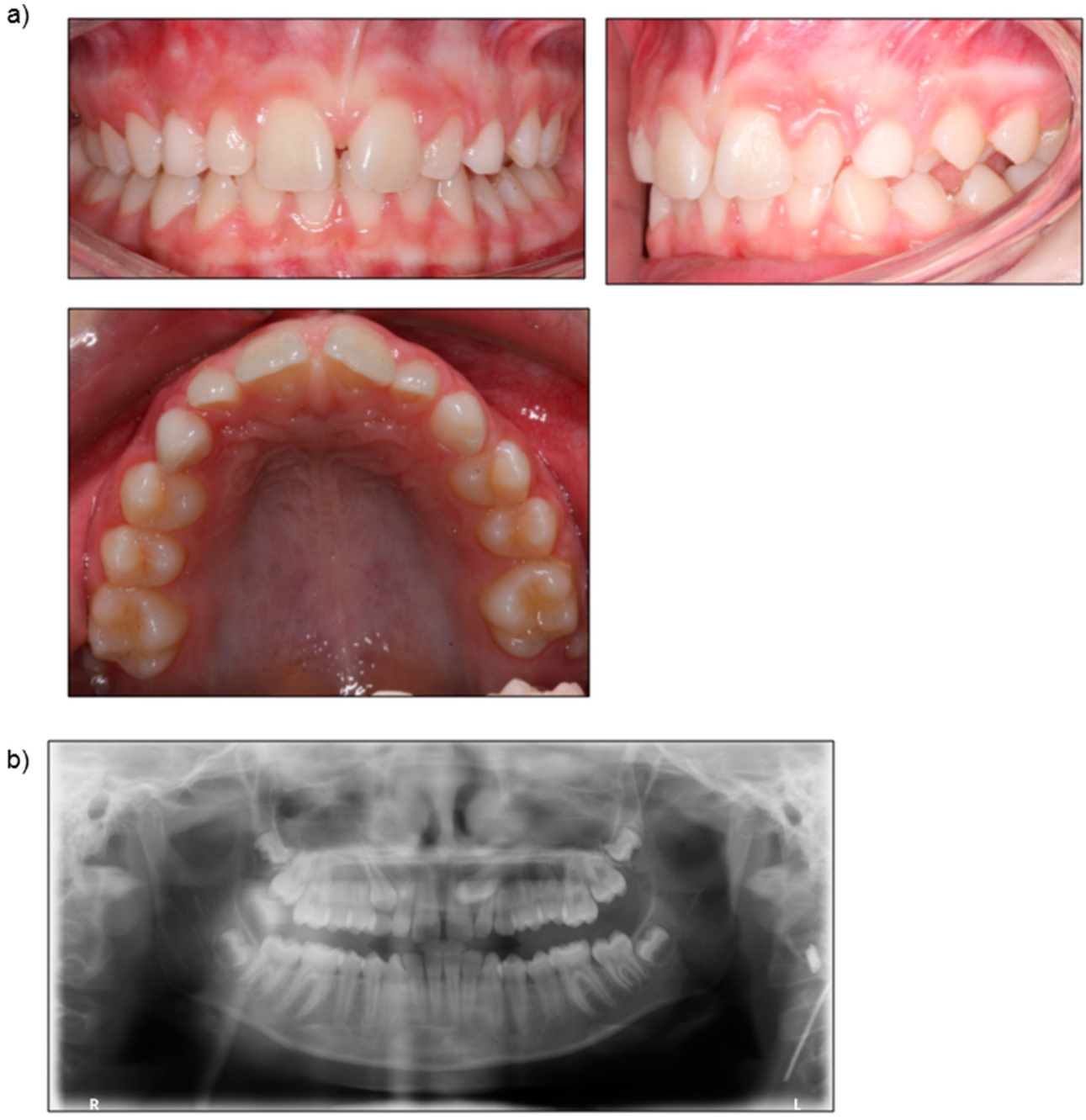

Figure 1. Pre-treatment photograph (a) and radiograph (b) showing a Class I occlusion with bilateral unerupted maxillary canines, retained primary canines and diminutive lateral incisors.

the incisal tip positioned close to the maxillary midline at the height of the mid-point of the central incisor root.

Treatment

The treatment plan involved open surgical exposure of the maxillary left canine tooth followed by orthodontic alignment and correction of the malocclusion with pre-adjusted edgewise appliances. Long-term retention with fixed retainers in the labial segments was planned following post-orthodontic composite restoration of the maxillary lateral incisors to manage the tooth size discrepancy.

Initial treatment progressed without complications. The maxillary left canine was exposed to an open exposure technique and allowed to erupt for 3 months (Figure 2(a)). Once an adequate amount of canine crown was visible, an attachment was bonded to allow traction to a transpalatal arch using the elastomeric chain to disimpact the tooth (Figure 2(b)). A maxillary pre-adjusted edgewise appliance was placed to provide anchorage for derotation and alignment of the left

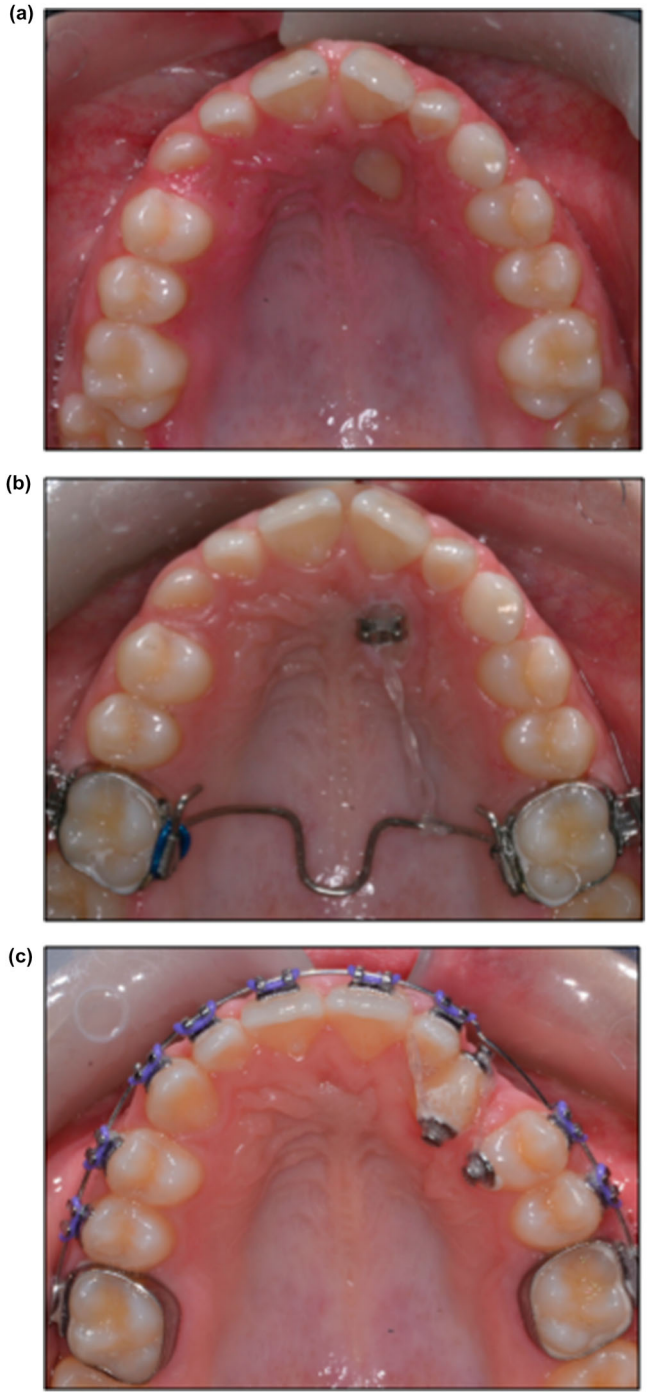

Figure 2. Exposure and alignment of the left maxillary canine. The canine underwent open surgical exposure without placement of an attachment (a). After 3 months a transpalatal arch was placed to enable traction to disimpact the canine (b). A maxillary fixed appliance was used to provide anchorage for derotation and alignment of the canine (c).

maxillary canine (Figure 2(c)). A standard procedure for bonding the fixed appliance was following using Transbond^{TM} self-etching primer (Unitek 3M) and Transbond light cure adhesive (Unitek 3M). The adhesive was set with a LED curing light held close to the bracket for 10 seconds, as per the manufacturer guidance. Patient cooperation was good and there was no indication that an incomplete cure may have occurred.

Approximately 12 months into fixed appliance therapy, SW reported occasional lip swelling in the mornings (Figure 3). Gingival inflammation was noted around the appliance despite good oral hygiene. No gastrointestinal symptoms were elicited and SW reported no changes in diet, product-use or medications. An allergic reaction to the nickel components of the fixed appliance was judged to be the most likely cause. Details of the

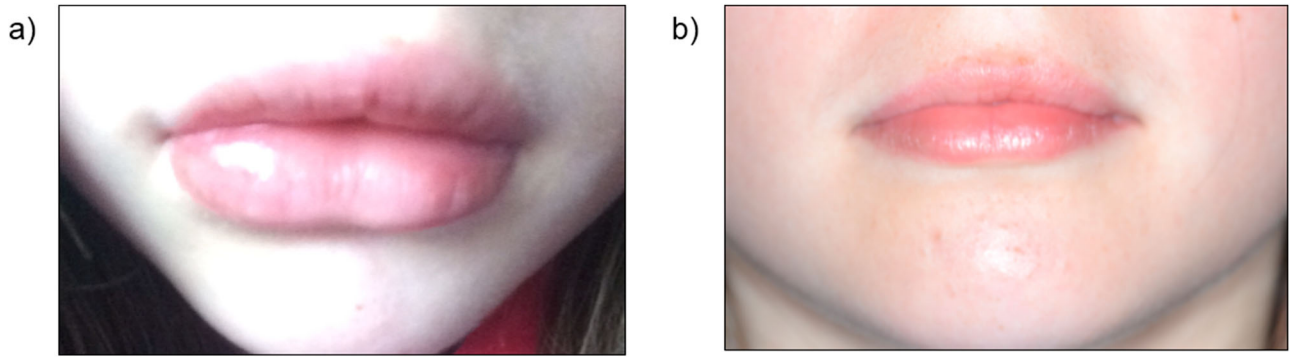

Figure 3. 12 months after placement of the maxillary fixed appliance SW started to experience episodes of lip swelling. Photograph taken by SW during an episode of lip swelling (a). SW presented later the same day to the Orthodontic Department but most of the lip swelling had largely resolved by this time (b).

case presentation and treatment to date were sent to the dermatology team with a request for patch testing for all possible allergens. No samples of the composite and bond were provided. The results indicated no reaction to nickel but a positive reaction to acrylates. The dermatologist advised removal of all sources of acrylate to prevent further sensitisation and symptoms.

The maxillary fixed appliance and composite adhesive were removed under high-volume suction and replaced using a conventional chemical-cure glass-ionomer cement (GIC) adhesive (Ketac™ Cem, 3M ESPE). Brackets were replaced with bands where heavy occlusal forces were anticipated (Figure 4). No attachment was placed on the maxillary left canine tooth due to the extent of inflammation.

Over the following months, lip swelling ceased and the majority of the gingival inflammation resolved, however, gingival hyperplasia persisted around the maxillary left canine. While efforts were made to remove all composite from the tooth, it is possible a small amount of adhesive remained where gingival inflammation restricted access. An apically repositioned flap was required to enable bracket placement (Figure 5).

Prior to bonding with GIC, SW experienced no bond failures. Following the change in adhesive, numerous bond failures occurred, particularly affecting the incisors. After 4 years of treatment, SW was happy with her occlusion and felt attendance at appointments was affecting her schoolwork and extra-curricular activities. SW requested removal of the appliances before occlusal detailing was complete and although canine alignment was achieved, the final occlusion was suboptimal (Figure 6). There were minor discrepancies in tooth position, notably the maxillary right lateral incisor, and the left canine required further buccal root torque. Restoration of the diminutive lateral incisors was contraindicated, resulting in a slightly Class II buccal segment relationship. SW was provided with a vacuum-formed retainer made from Essix C+ polypropylene.

Discussion

Acrylates are used in a number of resin-based dental materials including denture bases and liners, tissue conditioners, light-cured cavity liners, dentine-bonding agents, resin-based primers, adhesives and restorative

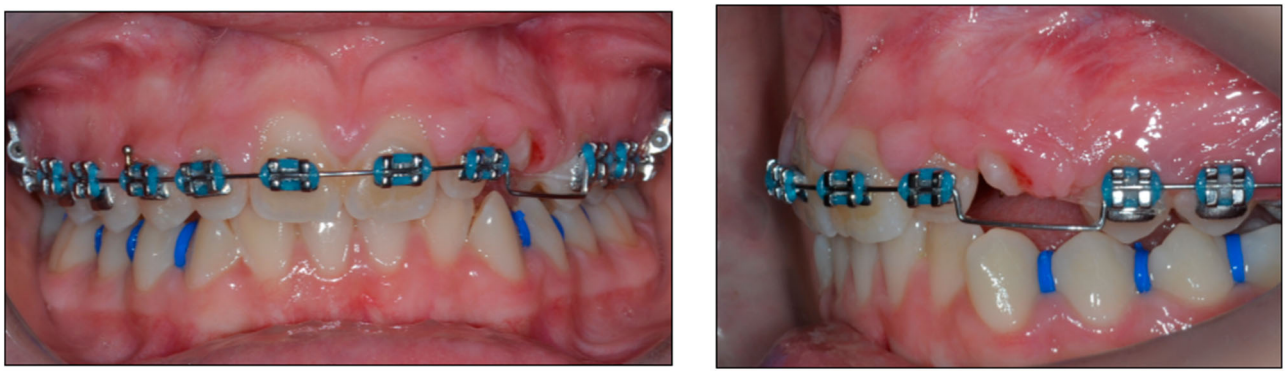

Figure 4. Gingival inflammation around the buccal aspect of the maxillary fixed appliance due to a reaction to the acrylate components of the fixed appliance adhesive. The fixed appliance was removed under high volume suction and rebonded with GIC. Bands were planned in the lower arch to reduce the risk of bond failure resulting from the reduced bond strength of GIC. No attachment was placed on the left maxillary canine to encourage resolution of the gingival inflammation.

Figure 5. Persistent inflammation was seen around the maxillary left canine after 3 months despite removal of all composite adhesive. An apically repositioned flap was required to enable bonding to the buccal surface.

materials. An extensive search of the literature found a handful of reports of acrylate allergy in dental patients arising from methacrylate components of dental prostheses (Jovanovic et al. 2010; Ramos et al. 2014; Syed et al. 2015; Shono and Ando 2016) and longstanding anterior composite restorations (Moore et al. 2000). The oral manifestations varied from burning, pain and dryness of the mucosa to a non-specific lichenoid reaction, stomatitis and cheilitis.

The primary use of acrylates in orthodontics is in the attachment of fixed appliances with resin-based primers and composites. Whilst uncured dental resin

Figure 6. End of treatment: The maxillary left canine was successfully aligned, however, the occlusal outcome was compromised by repeated bond failures causing SW to request appliance removal before occlusal detailing was achieved. The maxillary left canine is under torqued and the right lateral incisor is intruded. The buccal relationship was ¼ unit Class II because it was not possible to enlarge the dimunitive lateral incisors with adhesive bonding.

acrylate monomers are strong irritants, and incomplete conversion during polymerisation can result in immediate release of polymeric material, it is not generally anticipated that sufficient long-term degradation of composite occurs with an orthodontic adhesive to cause a reaction (Gupta et al. 2012). The sensitising potential of two orthodontic bonding materials was highlighted in a study in 1994, however, this used an animal model (Söhoel et al. 1994). No subsequent studies have measured the degradation of composite resin and the associated release of leachable components from orthodontic resin adhesives.

In the previous report of acrylate allergy in an orthodontic patient, the author reports a negative reaction to methylmethacrylate and highlights that the particular sensitising agent was not one of the usual constituents of composite or acrylic resins (Hutchinson 1994). Unfortunately, the primer and bonding agent used for SW were not sent for patch testing because the treating clinicians did not expect a diagnosis of acrylate allergy. Inclusion of specific dental materials in the patch testing may have enabled confirmation of the constituent components that initiated the hypersensitivity reaction. In light of the increasing frequency of acrylate allergies and the wide variety of acrylate monomers available on the market, it may be advisable to provide dental materials for patch testing as routine practice.

Hypersensitivity reactions may present a number of challenges to orthodontic treatment, as demonstrated by SW. Treatment time was extended due to gingival inflammation caused by the acrylate, suspension of treatment during patch testing and repeated bond failures with GIC adhesive. Conventional chemical-cure GICs have been suggested to have lower bond strength and greater bond failures when used as an orthodontic adhesive (Millet and McCabe 1996; Norevall et al. 1996). The repeated bond failure resulted in SW opting to terminate treatment before occlusal detailing was achieved. Avoidance of acrylate-containing materials prohibited the placement of a bonded retainer and adhesive bonding to the diminutive lateral incisors. After liaison with the laboratory technician, acrylate-free removable retainers were produced from a routinely used propylene material without detriment to the quality or effectiveness of the appliance. However, for other laboratory-made appliances acrylate monomers are a key component of the acrylic baseplate and their avoidance would be more challenging.

Acrylate-based materials are widely used outside dentistry in personal care products and there is growing concern that this repeated exposure will increasingly sensitise predisposed individuals. In 2012, the American Contact Dermatitis Society named acrylates as 'Contact Allergen Of The Year' (ACDS 2017) and the growing problem has led to a release of fact sheets (Contact Dermatitis Institute 2014), and a dedicated website (Acrylate Allergy Awareness 2018). Social media groups also exist, aiming to raise awareness and provide advice.

The increasing frequency of acrylate allergies has a potentially wider impact on dentistry. Concerns about the safety of amalgam as a dental material, combined with the Minamata Treaty 2013 commitment to reducing mercury in the environment, has increased pressure to seek alternative dental materials (British Dental Association 2017), many of which are acrylate-based. Adhesive bonding is central to minimally invasive restorative techniques. Cosmetic dentistry, orthodontics and laboratory-made prostheses are all heavily reliant on acrylate-containing materials. Biocompatibility issues with acrylates may present complications for treatment planning individual cases and with the provision of dental services as a whole.

In this case, the positive result to acrylates during patch testing provided a likely explanation to the signs observed in SW and guided the approach to management. It should, however, be noted that the presenting symptoms, namely occasional lip swelling in the morning and gingival inflammation, do not correspond to either Type I or IV hypersensitivity. Furthermore, removal of the composite did not completely resolve the gingival swelling and SW continued to experience occasional swelling of the lips for some months. It is possible that other factors caused the symptoms and the acrylate allergy was a coincidental finding. The most likely alternative explanation for gingival inflammation was an exaggerated response to low levels of plaque stagnation around the orthodontic appliance, possibly exacerbated by pubertal hormones or mouth breathing (Beaumont et al. 2017). No potential triggers for the lip swelling were identified from SW's medical history, lifestyle or from the timing of episodes.

A case report in 2015 described an orthodontic patient who was diagnosed with delayed pressure urticaria after experiencing repeated episodes of lip and gingival oedema immediately after adjustments to her fixed appliances (Shargill and Asher-McDade 2015). SW's episodes of lip swelling did not correlate with her orthodontic appointments and she did not report a history of lip swelling after routine dental visits; however, it is possible that the lip swelling was a variant of delayed pressure urticaria.

Conclusions

Acrylates can cause hypersensitivity reactions in both patients and dental professionals. Reactions to acrylate-based materials restrict the suitability of certain dental

treatments and patients must be informed of the impact this may have on dental care. The issue of acrylate allergy is a potential concern for dental care planning and provision on an individual and population level. If acrylate allergy is suspected, it is advisable to send samples of the materials in use for patch testing to assist identification of the constituent component causing the reaction.

Disclosure statement

No potential conflict of interest was reported by the authors.

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