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Allergies and its management in orthodontics

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Abstract
Allergic reactions are of increasing concern to practitioners in health-related fields. In modern orthodontic practice, adverse patient reactions to orthodontic materials are of both an irritant and a allergic in nature. Allergy in patients undergoing orthodontic treatment can be seen due to several reasons and these include nickel allergy, allergy to the acrylic resins that are used during treatment, latex products, etc. Safe and effective practice depends on identifying patients with allergy along with knowledge of materials that can potentially cause them. The Orthodontists should have basic understanding of allergic reactions and should be efficient enough to manage them. The aim of this paper is to review and analyse critically the current available literature in the field of allergy in orthodontics and to provide clinical implications based on scientific evidence on the topic.

Keywords: allergy, orthodontics, management

Introduction
Allergic reactions are of increasing concern to practitioners in health-related fields. In modern orthodontic practice, adverse patient reactions to orthodontic materials are of both an irritant and a allergic in nature. An allergic response is one in which certain components of the immune system react excessively to a foreign substance. Two key allergic reactions have been described in the literature. Type I hypersensitivity reactions are an immediate antibody mediated allergic response, occurring within minutes or hours after direct skin or mucosal contact with the allergen [1]. This reaction ranges from contact urticaria to full-blown anaphylaxis with respiratory distress and or hypotension. A delayed hypersensitivity reaction (Type IV), delayed-type hypersensitivity reactions (Type IV allergic reactions) are allergic immune reactions manifesting primarily through T cells (Cellular immunity) [2]. This process has two interrelated, distinct phases. A sensitization phase occurs from the moment the allergen enters the body, is recognized and a response occurs. The elicitation phase occurs after re-exposure to the allergen to the appearance of the full clinical reaction. It presents with diffuse or patchy eczema on the contact area and may be accompanied initially by itching, redness, and vesicle formation. Both types of allergic reactions require several prolonged contacts with allergens. Allergy in patients undergoing orthodontic treatment can be seen due to several reasons and these include nickel allergy, allergy to the acrylic resins that are used during treatment, latex products, etc. [3] There is rising concern about the biocompatibility of dental materials; this might be due to a real increase in the occurrence of allergic reactions to the materials or to an increase in awareness of adverse effects from these materials. Safe and effective practice depends on identifying patients with allergy along with knowledge of materials that can potentially cause them. The Orthodontists should have basic understanding of allergic reactions and should be efficient enough to manage them. The aim of this paper is to review and analyze critically the current available literature in the field of allergy in orthodontics and to provide clinical implications based on scientific evidence on the topic.

Nickel Allergy
Nickel alloys are widely used in the orthodontic in brackets, wires, bands and other orthodontic accessories. Nickel allergy occurs more frequently than allergy to all other metals combined [4]. It is estimated that 11% of all women and 20% of women between the ages of 16 and 35 years have a sensitivity to nickel [5].

Nickel-induced contact dermatitis is a type IV delayed hypersensitivity immune response occurring at least 24 hours after exposure [2, 6]. It has been shown that the level of nickel in saliva and serum increases significantly after the insertion of fixed orthodontic appliances [1]. Nickel leaching from orthodontic bands, brackets, stainless steel or Ni–Ti archwires has been shown *in vitro* to occur within the first week and then decline thereafter [7]. It is suggested that a threshold concentration of approximately 30 ppm of nickel may be sufficient to elicit a cytotoxic response [8]. Scientific evidence suggests that orthodontic treatment is not associated with increase of Ni hypersensitivity, unless patients have a history of previous exposure to Ni. People with cutaneous piercing are considered a significant risk factor for Ni allergy [9]. however, oral exposure to nickel through dental braces prior to ear piercing reduces the risk of developing nickel allergy [10]. Previous allergic response after wearing earrings or a metal watchstrap, appearance of allergy symptoms shortly after the initial insertion of orthodontic components containing Nickel and confined extra-oral rash adjacent to headgear studs should raise alarm to clinician concerning nickel allergy. Signs and symptoms of nickel allergy includes gingivitis, gingival hyperplasia, lip desquamation, burning sensation in the mouth, metallic taste, angular cheilitis, and periodontitis [11, 12]. In chronic cases, the affected mucosa is typically in contact with the causal agent and appears erythematous or hyperkeratotic to ulcerated.[13] Extraoral manifestations of nickel allergy may have an intraoral origin [14]. If a nickel allergy is still in question, a diagnosis can be confirmed by a dermatologist by conducting a cutaneous sensitivity test called a patch test (Table 1) using 5% nickel sulphate in petroleum jelly [15]. If intra- oral signs and symptoms (Table 2) are present and a diagnosis of nickel hypersensitivity is established, the fixed or removable prosthesis should be replaced with another nickel free alloy (Table 3 and 4). The nickel titanium archwires should be removed and replaced with a stainless steel archwire which is low in nickel content or preferably a titanium molybdenum alloy (TMA) archwire, known as "TMA", which does not contain nickel [16]. Most patients who develop a reaction to Ni-Ti archwires subsequently tolerate stainless steel without a reaction [17]. Other options include Fiber reinforced composite wires, Gold plated wires, Ion-implanted nickel-titanium archwires or Plastic/Resin-coated nickel-titanium archwires [16]. Stainless steel brackets are generally considered safe [18]. However, nickel free alternative brackets to stainless steel include Ceramic brackets produced using polycrystalline alumina, single crystal sapphire, and zirconia, Polycarbonate brackets, Titanium brackets and Gold plated brackets and plastic brackets in selected cases Fixed appliances may be substituted with plastic aligners. Extra-oral metal components, including metal studs in headgear, are of greatest concern due to greater sensitivity of skin. Plastic coated headgear studs may be a better alternative for such patients.

Table 1: Reading of patch test

Result	Score	Reaction
Negative	1	Absent
	2	Light erythema
	3	Erythema
Positive	4	Erythema, edema, papules
	5	Erythema, edema, papules, vesicles

Table 2: Signs and symptoms of Nickel allergy

Intra-oral	Extra-oral
Stomatitis from mild to severe erythema	Generalized urticarial
Papula peri-oral rash	Widespread eczema
Loss of metallic taste	Flare –up of allergic dermatitis
Numbness	Exacerbation of pre-existing eczema
Burning sensation	
Soreness at the side of the tongue	
Angular cheilitis	
Severe gingivitis in the absence of plaque	

Table 3: Nickel-free and nickel-'lite' wires and brackets

Company	Nickel-free products	
	Wires	Brackets
RMO Europe t www.rmortho.com	Bendalloy TMA wire	Ceramic: Signature 3, Luxi 2 with gold slot
The Orthodontic Company www.tocdental.com	Resolve TMA wire Bioforce wire with ionguard Epoxy coated wires	Ion-implanted stanless steel: Platina Ceramic with glass slot: Mystique Plastic: Oyster ligature free
3M Unitek www.3M.com/Unitek	Beta III Titanium	Ceramic: Transcend, Clarity with stainless steel slot 24 carat gold-plated brackets
Forestadent www.forestadent.com	TMA wire Flat Line acrylic coated wire Titanium coated archwire	Ceramic with gold slot: Aspire Plastic: Brilliant
American Orthodontics www.americanortho.com	Beta Titanium wire	White gold _60% paladium: Virage Polycarbonate 20/40 Reinforced polycarbonate: Silkon Urethane: Classic
TP Orthodontics www.tportho.com	Timmolium (TMA)	Nickel 'free' stainless steel: Avid Ceramic: MXI Cobalt chrome: Nu edge
Ormco/A Company www.ormco.com	TMA	Ceramic: Inspire Gold: Ortho 2

		Titanium brackets
The Dental Directory www.dental-directory.co.uk	Betaforce beta titanium	Composite with metal slot: Avalon
HSR Primo www.hsrprimo.co.uk	Biosteel (0.2% Ni)	Siliaceous copolymer—Natura
Ortho-care www.orthocare.co.uk	Gold-plated wires Beta titanium wire	Polycarbonate: Polar, Polar plus with gold slot Ceramic: Desire with gold slot
Precision Orthodontics www.orthoorganizer.co.uk	Nickel-lite: Cobalt chromium alloy CNA beta titanium Gold-plated wires Resin coated wires	Composite with gold slot: Envision Ceramic: Illusion, Contour Nickel-lite: Cobalt chromium alloy Gold-plated brackets

Table 4: Other nickel-free and nickel-'lite' products

Company	Other products
TP Orthodontics www.tporto.com	Plastic-coated headgear
Masel www.maselortho.com	TMA expansion screw
Sheffield Orthodontic www.orthounlimited.com	Nickel-'free' ss wire for removeable appliances
The Orthodontic Company www.tocdental.com	Glass fibre buccal tubes Epoxy-coated quick-tie ligs
Ormco/A Company www.ormco	Titanium buccal tubes

Latex Allergy

Exposure to natural rubber latex (NRL) in the clinical environment has increased significantly since the mid- 1980s. Natural rubber (Latex) is a milky juice obtained from rubber tree, Hevea Brasiliensis. There has been increase in allergic reactions to natural rubber latex (NRL) over the past two decades due to increased in the use of latex based gloves as universal precaution measures. Jacobsen and Hensten Pettersen found that, from 1998 to 2000, there had been a ten-fold increase in reported reactions to NRL during orthodontic treatment [3]. Natural rubber latex is found in gloves, intra- and extra-oral elastics, separators, elastomeric modules, elastomeric power chain, polishing rubber cups, band removers. The allergic compounds from natural latex include chemical substances associated to vulcanization, such as residual proteins and chemical substances from powder or talc. With latex both type I and type IV hypersensitivity reactions can occur. The prevalence of potential type I hypersensitivity to latex is lower than 1% in the general population and between 6–12% among dental professionals [19]. Immediate (Type I) IgE Antibody mediated response to NRL usually occurs within 5–60 minutes of contact with allergen. Severe systemic reactions, involving the skin, airways and/ or cardiovascular systems, have been reported after cutaneous and respiratory exposure [20]. More than 10 deaths have been attributed to latex anaphylaxis [21]. Contact dermatitis is a T cell mediated, delayed hypersensitivity (Type IV) reaction. The allergens usually responsible for triggering the allergic reaction are the chemical accelerators like thiurams, carbamates and benzothiazoles that are used in the glove-manufacturing process [20]. Allergic contact dermatitis can result in an eczematous rash that is typically pruritic. If the mucosa is involved, it may swell, become erythematous or develop small vesicles. patient may also complain of a burning or itching sensation in the affected area [22]. The prevalence of NRL allergy has been reported as being less than 1% in the general population, 5–15% in HCWs and 24–60% in patients with spina bifida [23]. Definitive diagnosis should be based on the medical history, and a positive skin reaction to specific chemicals present in natural rubber latex. A standard medical history should identify patients with confirmed NRL allergy. However, additional information pertinent to NRL allergy should be sought to help identify other patients at potentially increased risk of developing NRL allergy. Hypersensitivity to certain foods such as avocados, potatoes, bananas,
tomatoes, chestnuts, kiwi fruit and papaya is associated with NRL allergy [24]. A history of 'asthma-like' symptoms and previous adverse reactions following possible exposure to NRL-containing products also requires further investigation. Confirmation of latex allergy should be obtained by doing latex epicutaneous skin test using natural latex, to determine the presence of circulating antibodies to latex. It seems prudent that when treating patients with clinical and immunological evidence of NRL allergy, contact with potential allergens should be avoided. Patient should be managed in a 'latex-screened' environment and should be monitor every appointment for any signs of adverse reactions. There are a number of latex free alternatives to commonly used orthodontic materials (Table 5). In the latex sensitive patient, steel ligatures or self-ligating brackets may be preferred. Elastomeric separators can be replaced with self-locking separating springs [25]. Synthetic non-latex gloves made from nitrile, polychloroprene, elastyren and vinyl, are readily available for clinical use. NRL-free elastics are available but they showed greater hysteresis than NRL elastics i.e. 40% force decay as opposed to 25% over 24 hours [26]. Although NRL-free elastics do not perform as well as NRL elastics in laboratory
studies, it is unlikely that the relatively small mechanical differences in force decay would have a clinically significant effect.

Table 5: Examples of NRL-free products for use in orthodontics.

Intra-oral	Extra-oral
Inter-arch elastics	GAC (www.gacintl.com): NRL-Free Elastics; Leone (www.leone.it); Dentaurum (info@dentaurum. de): intra-oral elastics
Intra-arch elastics	3M Unitek (3M.com): Alastic range of power chain and modules; Dentaurum Dentalastics: plastic ligatures, ligature chain, rotation wedges, 'Personal' coloured modules, Elasto-Force plastic chain; TP Orthodontics (tportho@tportho.com): ligatures, e-links, e-chain
Headgear	TP Orthodontics: headgear components; 3M Unitek: headgear components, except lining in chin cup which does contain NRL
Separators	TP Orthodontics: self-locking separator springs, sep-a-rings; Dentaurum Dentalastics: separators

Self-ligating brackets	Damon (www.ormco.com); Speed (www.speedsystem.com); Innovation (GAC); SmartClip (3M Unitek)
Nickel titanium springs	GAC; Leone; 3M Unitek; Dentaurum
Band remover	3M Unitek; TP Orthodontics
Polishing brush/cup	Contra petite Web disposable (www.youngdental.com)
Gloves	Kimberly-Clark (www.kchealthcare.com): Safeskin Purple Nitrile; Bodyguards Nitrile Gloves (www.medisavers.co.uk); Schottlander (www.schottlander.co.uk): NRL-Free Nitrile; Regent (www.regentmedical.com): Biogel Skinsense PI
Masks without NRL ties	Kimberly-Clark: Technocol Soft, Technocol Fluidshield

This table is not exhaustive, and manufacturing processes may change. It is prudent to check with the manufacturer that their products are NRL free.

Acrylic resin allergy

Acrylic resins are widely used in dentistry, especially in orthodontics and prosthodontics. Increasing concerns about the biocompatibility of this material were evident a decade ago, when reactions were described in the literature [27-29]. Acrylic resins based on methylmethacrylate can produce type IV hypersensitivity reactions, which happen after re-exposing a subject to the allergen. Nealey and Del Rio [27] described stomatitis venenata, a contact allergy caused by a prosthesis constructed of self-curing acrylic resin. McCabe and Basker [28] reported 2 cases of sensitivity to acrylic and linked these reactions to the levels of residual monomer (0.233% and 0.186%, analyzed by gas chromatography). Likewise, allergic reaction to methylmethacrylate was shown by Giunta and Zablotsky, [29] confirmed by patch testing and histopathologic evaluations. Many authors agree that residual monomer leaching into the oral environment is a main cause of allergic reactions. The residual monomer contents are usually about 1.5% to 4.5% in self-curing acrylic resins and about 0.3% in heat-curing resins [30]. Generally, allergic reactions to acrylic are local manifestations, but there are different clinical presentations like labial edema, [31] erythema delineating the contact area, Burning sensations and chronic urticaria [32]. Although it is widely used, the orthodontic literature contains little information about allergic reactions to this material. Tatiana Siqueira Gonçalves *et al* in 2006 reported a case of allergy cause by a removable retainer constructed of clear self-curing methyl methacrylate acrylic resin. Continued use of acrylic appliance even after seeing the initial intraoral manifestation may also lead to gum hypertrophy in the adjoining area Although reactions to this kind of allergen are rare,[33] awareness of local and systemic manifestations is important in orthodontic practice when a patient's general health is concerned. Owing to the frequent contact with, methacrlate resin Dental Health Care Workers are at increased risk of developing allergy. Kerosvo *et al* in 2000 conducted a survey on occupational problem among Finnish population in relation to orthodontics. They concluded that methacrylate and latex gloves were the two most commonly reported cause of hypersensitivity among clinician's. The adverse effects of acrylics were attributed both to the monomer during handling process of the material and to the acrylic dust generated during grinding of acrylic appiliance [34]. Suspicious changes should be investigated by a dermatologist and, whenever possible, confirmed by patch test. Overcoming allergic reactions in denture patients sensitized by methylmethacrylate might require, according to Kanerva *et al*, [35] 1 of 6 possibilities: cover the prosthesis with light polymerized methyl methacrylate, cover it with ultraviolet polymerized urethane acrylate, cover it with ultraviolet polymerized methacrylate, use a polycarbonate prosthesis, use vulcanite, or use titan associated to ceramic teeth. A patient allergic to methylmethacrylate was shown to also have positive patch test results to polysulfone and polycarbonate, leaving urethane dimethacrylate as the only choice [36]. Instead of methacrylate resin Clear aligner can be used as a retainer to avoid the allergic reactions. A bonded lingual retainer can be used instead of acrylic based removable retainer.

Other metal allergy

Chromium is the second most frequent metal to cause contact dermatitis [37]. Luciane *et al* in 2004 in their study demonstrated high sensitivity rates to chromium, in orthodontic patients (21.1%), though greater tendency to positivity was found in male patients as compare to female.[38] The chances of an adverse reaction to chromium found in dental materials, appears to be rare [39]. Similarly documented cases of platinum hypersensitivity are even rarer than chromium allergy.[40] Resin composite materials could be an etiologic factor in the development of lichenoid reactions in the oral mucosa.[41] The pathogenic mechanism may be related to contact allergy to formaldehyde formed in resin composite restorations. Though the chances of an adverse reaction to these dental materials, appears to be remote clinicians should nevertheless always be on the alert.

Conclusion

Safe and effective practice depends on identifying patients with allergy along with knowledge of materials that can potentially cause them. Diagnosis and treatment should include a multidisciplinary team. It is imperative for a practitioner to not only know the physical and mechanical properties of the materials being used, but also of the biologic compatibility of the material. Knowledge of alternatives to allergy-causing materials is also of prime importance in efficient management of patients in routine clinical practice. The clinician should be mindful of these reactions during the course of orthodontic treatment, and should know to diagnose and subsequent action to be taken in treatment plan. In all instances, the patient's well-being should guide treatment decisions, and general health-not just oral health-should be the goal.

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