

CLINICAL  
SECTION

# Natural rubber latex allergy: implications for the orthodontist

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Natural rubber latex (NRL) allergy can have potentially serious consequences, and reports of orthodontic patients reacting to NRL have increased significantly over recent years. It is therefore important for the orthodontist to know how to manage patients with an NRL allergy and how to deal with possible reactions to NRL. Safe and effective practice depends on recognizing patients who are at risk of NRL allergy, and an awareness of materials and equipment that contain NRL and the availability of suitable NRL-free alternatives.

*Key words:* NRL, elastics, rubber, latex, allergy, latex-free

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## Introduction

Exposure to natural rubber latex (NRL) in the clinical environment has increased significantly since the mid-1980s because of concerns over the transmission of viral infections, such as human immunodeficiency virus (HIV) and hepatitis B. This has resulted in protective gloves, usually made from NRL, being worn routinely for clinical procedures where contact with bodily fluids may occur. The increase in the use of NRL clinical gloves has been accompanied by a rise in the incidence of NRL allergy in health-care workers (HCWs) and patients.<sup>1,2</sup>

This article describes possible reactions to NRL in orthodontics. After a brief description of the processes underlying the different reactions to NRL, the diagnosis and orthodontic management considerations are discussed.

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, while reports of reactions to the metallic components used during orthodontic treatment had actually decreased.<sup>1</sup> In orthodontics, as well as in the gloves that are routinely worn when treating patients, NRL is also present in other materials such as inter- and intra-arch elastics. These elastics often play an important part in orthodontic mechanics, due to their ability to exert a predictable force and their low cost.<sup>3</sup> Other sources of NRL are discussed later in the article.

Russell *et al.* found only three reports in the literature relating NRL allergy to orthodontic treatment.<sup>4</sup> Two of these studies related the allergic reaction to the use of

NRL gloves,<sup>1,5</sup> and a third related the development of stomatitis to the use of orthodontic elastics.<sup>6</sup> Jacobsen and Pettersen surveyed Norwegian orthodontists who had treated approximately 41,000 patients from 1998 to 2000. This group reported 14 reactions to elastics and one anaphylactoid reaction to gloves. The commonest sites affected were the gingivae and tongue, but the perioral region was also affected. The data were collected by questionnaire, and an 'assumed' causal link was not always investigated.<sup>1</sup>

NRL sensitivity is associated with atopy, reflecting a predisposition to producing IgE antibodies. The main types of reaction to NRL are irritant contact dermatitis, allergic contact dermatitis and NRL allergy. Owing to the uncertainties regarding the diagnostic reliability of the current tests, estimates of the prevalence of NRL allergy vary considerably, depending on which diagnostic tests are used and the population tested. 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.<sup>7</sup>

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.<sup>8</sup> A history of 'asthma-like' symptoms and previous adverse reactions following possible exposure to NRL-containing products also requires further investigation.

## Manufacturing process of NRL

An awareness of how NRL is manufactured and an appreciation of the processes underlying the different reactions to NRL-containing materials are helpful when trying to understand and manage the clinical issues.

NRL is the sap of the commercial rubber tree *Hevea brasiliensis* and contains over 200 polypeptides, not all of which are recognized as allergens. NRL is used either to produce dry rubber goods, such as tyres, or dipped goods, such as gloves. During the manufacturing process, various chemicals, e.g. thiurams and carbamates, are added to the NRL. These additives have long been recognized as a cause of allergic contact dermatitis.<sup>7</sup>

## Types of reaction to NRL

### *Irritant contact dermatitis*

Irritant contact dermatitis is the most frequent cause of hand eczema. It results from a combination of chemical/mechanical irritation and is not an allergy to proteins or chemicals.

Typically, irritant contact dermatitis starts along skin folds or under a ring and tends to present as dry irritable patches or as chapping on the hands. Predisposing factors include perspiration trapped under gloves and residue from soaps. The use of an appropriate hand protection regime will minimize the risk of developing hand dermatitis. It has been suggested that eczematous skin is less of a barrier to allergens, so that subsequent sensitization may be more likely. Members of the dental team who develop any of the above signs or symptoms should have patch testing carried out to exclude allergic contact dermatitis.

### *Allergic contact dermatitis*

Allergic contact dermatitis is the result of delayed hypersensitivity (Type IV), and is a cell-mediated response to specific chemicals referred to as contact sensitizers. The allergens usually responsible for triggering the allergic reaction are the chemical accelerators (thiurams, carbamates and benzothiazoles) that are used in the glove-manufacturing process. At present, it is not clear whether NRL proteins may themselves cause a Type IV reaction.<sup>9,10</sup>

Allergic contact dermatitis can result in an eczematous rash that is typically pruritic. The skin may also be scaly, swollen or vesicular and weeping, with any reaction tending to peak approximately 48 hours after exposure to the allergen. If the mucosa is involved, it may swell, become erythematous or develop small vesicles. The

patient may also complain of a burning or itching sensation in the affected area.<sup>11,12</sup> Allergic contact dermatitis is not a life-threatening condition, and there is no firm evidence of any immunological association between Type I NRL allergy and the Type IV reaction to NRL additives.

A patient who gives a history of a reaction to NRL elastics that resolves upon changing the brand of elastics<sup>12</sup> is likely to have had a Type IV reaction to a chemical present in one brand of NRL elastics and not in the other. It may be possible to distinguish allergic contact dermatitis from irritant dermatitis by noting the extent of the spread of the reaction. Allergic contact dermatitis can often spread beyond the area of physical contact;<sup>13</sup> however, in most cases it will be the history and clinical presentation, followed by patch testing, that will confirm the diagnosis.

The diagnosis of NRL contact allergy is advantageous from both the patient and HCW perspective. The management of patients with delayed Type IV allergic contact dermatitis is less problematic than the management of patients with NRL allergy. Although the history can be quite effective at identifying this latter group of patients, it is essential that an appropriate specialist makes the diagnosis. While allergic contact dermatitis is not a life-threatening condition, it is still desirable to minimize NRL exposure for this group of patients. NRL-free gloves and materials should therefore be used (Table 1). It is, however, not essential to treat patients with an NRL contact allergy in a 'latex-screened' environment.

### *NRL allergy*

NRL allergy results from an immediate (Type I) IgE antibody-mediated response to NRL and usually occurs within 5–60 minutes of contact with NRL. However, the thresholds for sensitization and reaction are unknown.<sup>7</sup> Severe systemic reactions, involving the skin, airways and/or cardiovascular systems, have been reported after cutaneous and respiratory exposure. Mucosal and parenteral exposure to NRL allergens pose the greatest risk of anaphylaxis.<sup>7</sup> Powder has traditionally been added to gloves to facilitate donning. The powder (usually corn starch) has been shown to adsorb NRL proteins and therefore acts as a vehicle for the dissemination of allergens into the atmosphere. Aeroallergens have the potential to be potent sensitizers. The discontinuation of the use of powdered NRL gloves appeared to have been effective at reducing sensitization of dental students to NRL in one study.<sup>14</sup>

The face, especially the lips and mouth, is likely to be affected first if a dental patient develops an acute allergic

reaction to NRL. The patient's skin usually becomes itchy and develops weals, giving the skin a 'nettle rash' appearance. This may resolve in a relatively short time—usually about 30 minutes. Alternatively, the reaction may progress to involve the patient's airways and/or develop into a full anaphylactic reaction. If untreated, anaphylaxis may lead to a cardiac arrest.

### Testing for NRL allergy

Patients suspected of having an NRL allergy should be referred to an appropriate expert (usually an allergist, clinical immunologist or dermatologist) for testing. At present, none of the available tests for NRL allergy demonstrates complete diagnostic reliability. Despite this, it is usually possible to confirm a suspected diagnosis of a Type I NRL allergy by skin prick testing or immunoassay to detect NRL-specific IgE antibodies. However, Cullinan *et al.* stated that agreement between the results of skin prick testing and serological assays is not always good.<sup>8</sup>

Skin prick testing involves placing NRL extract diluted in saline on the skin and scratching the skin with a needle. The reaction is then compared to that obtained with a histamine control.<sup>15</sup> Immunoassays such as radio-allergosorbent testing (RAST) measure NRL-specific IgE to various allergy extracts. The patient's serum is initially reacted with the allergen and then incubated with radiolabelled anti-human IgE.<sup>15</sup> The presence of positive IgE test results, in the absence of clinical symptoms of NRL allergy, suggests cross-reactivity to other allergens. Structural homologies between *Havea* proteins and other plant/fruit proteins have been noted.<sup>7</sup>

In the light of current information, it seems prudent that when treating patients with clinical and immunological evidence of NRL allergy, contact with potential allergens should be avoided.<sup>7,8,16</sup> Members of the dental team therefore need to be familiar with and strictly adhere to NRL avoidance protocols in order to protect patients or staff with an NRL allergy. It may be that as knowledge and diagnostic techniques improve, these precautions will be shown to be over-zealous.<sup>16</sup>

## The management of orthodontic patients with NRL allergy

The remaining sections of this article relate specifically to Type I NRL allergy.

### Patients with suspected or proven NRL allergy (Appendix 1)

Exposure of patients who are sensitized to NRL to a product containing NRL could be potentially fatal. It is therefore best practice to:

- manage the patient in a 'latex-screened' environment;
- monitor the patient for signs of adverse reactions;
- ensure that resuscitation equipment is free from NRL;<sup>16</sup>
- ensure the capability of NRL-free delivery of emergency drugs.

### Creation of a 'latex-screened' dental environment

It is not feasible to achieve the total elimination of NRL from the dental environment (for example, staff clothes

**Table 1** Examples of NRL-free products for use in orthodontics.

Inter-arch elastics	GAC (www.gacintl.com): NRL-Free Elastics; Leone (www.leone.it); Dentaureum (info@dentaureum.de): intra-oral elastics
Intra-arch elastics	3M Unitek (3M.com): Alastic range of power chain and modules; Dentaureum 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, <i>except</i> lining in chin cup which does contain NRL
Separators	TP Orthodontics: self-locking separator springs, sep-a-rings; Dentaureum 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; Dentaureum
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.

may contain NRL elastic). The aim is therefore to create a 'latex-screened' environment in which exposure to NRL is reduced as far as is reasonably possible. NRL exposure can be minimized by measures such as decontamination of the surgery with a 'protein wash' and storing the NRL-free products in a 'latex-screened surgery' to avoid prior contamination by storage with NRL materials. NRL-free gloves must be worn in the latex-screened facility, and powdered NRL gloves should never be available in a clinical environment. Whether an orthodontic practice can be designated as 'NRL-screened' depends on a number of factors, including: staff experience and training, especially in the management of medical emergencies; the availability of NRL-free drugs and equipment; the organization of the practice; and financial and time constraints.<sup>16</sup> It is helpful to divide the clinical management of patients with NRL allergy into two phases: 'pre-treatment' and 'during treatment'. The salient features can be incorporated into a checklist (Appendix 1).<sup>16</sup>

#### *NRL-free gloves*

Synthetic non-latex gloves are readily available for clinical use, and include gloves made from nitrile, polychloroprene, elastyren and vinyl. The development and marketing of new gloves is a rapidly changing and competitive area. The choice of gloves is based on operational need and personal preference. The clinician needs to consider the level of comfort, the degree of dexterity required by a procedure, the infection risk, and the potential for allergic and other adverse reactions to gloves. All gloves, irrespective of the presence of latex, must meet the European standard for single-use medical gloves. Poley and Slater reported that the vinyl gloves available at the time had higher in-use leakage rates.<sup>7</sup> However, vinyl examination gloves for medical use that meet current glove standards are now available.<sup>16</sup>

#### *Orthodontic considerations*

NRL is commonly found in the dental surgery and in a number of orthodontic materials. Table 1 lists NRL-free alternatives to commonly used orthodontic materials and products that may contain NRL. Consideration, however, should also be given to general items of dental equipment that may be required, such as rubber polishing cups, alginate mixing bowls and local anaesthetic cartridges.<sup>16</sup>

Concerns about the mechanical properties of NRL-free elastics used in orthodontics have been raised.<sup>4</sup> The extension force pattern was reported to be different for NRL and NRL-free alternatives.<sup>4,17</sup> Silicone bands also

showed greater force decay, and it was concluded that great improvements in the physical properties of the silicone bands would be required before they could be considered as an acceptable alternative to NRL elastics. After static force extension of 450% for 1 day in saliva, the force decay was 33% for the silicone bands and 28% for the NRL elastics.<sup>17</sup> Russell reported that NRL-free elastics showed greater hysteresis than NRL elastics (40% force decay as opposed to 25% over 24 hours; furthermore, the range of forces produced by the NRL-free elastics was larger).<sup>4</sup>

The ideal force required to maximize the rate of tooth movement is still unknown, although most evidence would suggest that there is a wide force spectrum to which teeth will respond appropriately.<sup>18</sup> Clinical trials comparing rates of tooth movement in response to mechanics with very different force characteristics, i.e. nickel titanium springs, elastics and Bennett modules, still found each method to be clinically effective.<sup>19-21</sup> So, 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. No clinical trial has compared NRL and NRL-free elastics to date.

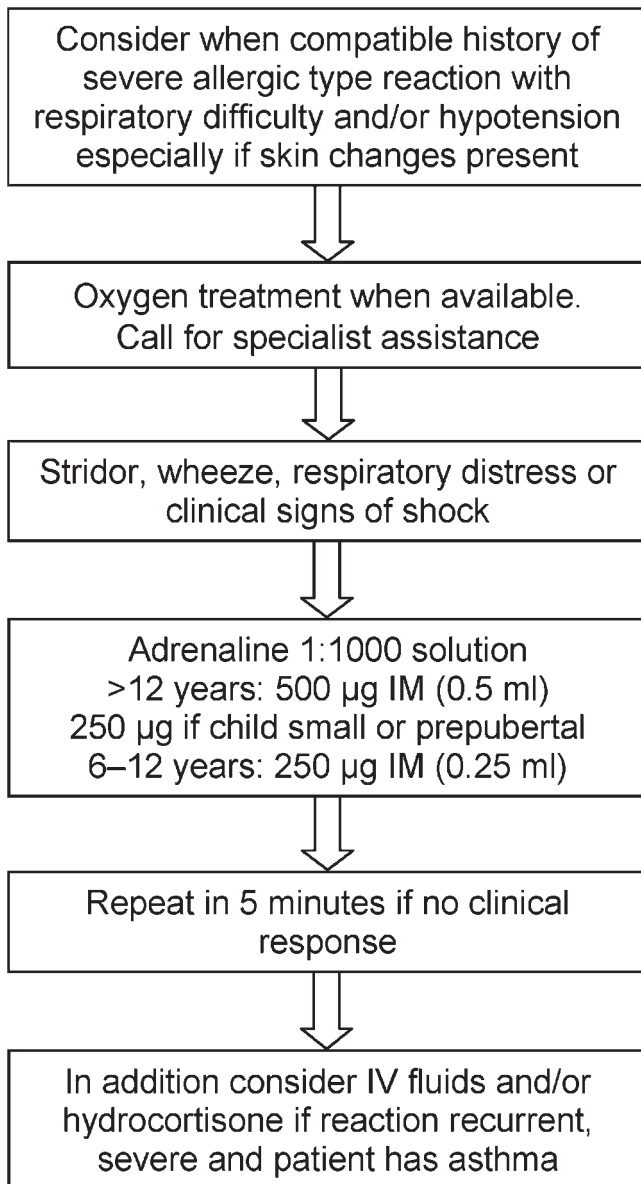
### **Management of a Type I allergic reaction to NRL during orthodontic treatment (Figure 1)**

The management will depend on the severity of the patient's reaction, which may range from contact urticaria (CU) to full-blown anaphylaxis. CU is managed by avoiding any contact with NRL and possibly administering an oral antihistamine such as chlorphenamine. The patient needs to be warned of the likelihood of drowsiness if a sedating antihistamine is used, and may be sent home accompanied after a few hours of observation.

A diagnosis of anaphylaxis can be made in the presence of respiratory distress and or hypotension. However, time should not be wasted in applying strict criteria in a deteriorating patient, and adrenaline should be given early (IM). The administration of salbutamol, chlorphenamine and hydrocortisone should also be considered.

### **Management of orthodontic staff with suspected or proven NRL allergy**

Owing to the frequent contact with NRL, dental HCWs are at increased risk of developing NRL allergy.<sup>14</sup> The Health and Safety Act 1974 requires employers to take all reasonable steps to ensure the welfare of their



**Figure 1** Anaphylactic reactions: treatment algorithm (adapted from resuscitation guidelines 2005)<sup>22</sup>

employees. As NRL comes under Control of Substances Hazardous to Health Regulations 1999, the employer is expected to institute preventive measures to control the risks posed by NRL. Employers are therefore expected to ensure that NRL gloves are only used if there is an operational need, that powdered gloves are not used and that only gloves with low leachable protein are made available for use. A protocol should also be available covering the protection of sensitive HCWs and the management of patients with NRL allergy.

Ideally, prospective employees should be screened for NRL allergy before they are employed. Advice can then

be sought from the local occupational health service (OHS) about the advisability of the staff member working in dentistry. If an HCW develops signs or symptoms of NRL allergy, they should contact an OHS physician so that investigations can be arranged and a diagnosis established. Fortunately, most cases of low-grade hand dermatitis are irritant rather than allergic and respond to a change in hand care regime.<sup>16</sup> If a diagnosis of NRL allergy is made, the safety of the working environment needs to be reviewed. If symptoms persist despite all attempts to provide a safe work environment, then relocation of the employee needs to be considered. It is a statutory duty of the employer to keep records of occupational dermatitis attributable to NRL and report these to the Health and Safety Executive. Adverse Reaction to Dental Materials can also be registered online at <http://arrp.group.shef.ac.uk>.

## Summary

NRL allergy is a significant clinical problem with potentially life-threatening complications. Risks can be minimized by:

- taking an up-to-date medical history;
- arranging investigations for patients with a suspected NRL sensitivity/allergy and ensuring that the patient is referred to an appropriate medical specialist;
- treating patients with a suspected or proven NRL allergy in a 'latex-screened' environment;
- selecting NRL-free orthodontic products;
- recognizing acute symptoms of NRL allergy and instigating prompt emergency treatment.

## Appendix 1: Checklist for patients with NRL allergy

### Pre-treatment

- Identify a member of staff to implement 'NRL allergic protocol' and train team.
- Ensure that all staff are aware of implication of treating NRL allergic patients.
- A sign on the surgery door should indicate 'latex-screened zone'.
- Case notes should be clearly marked to warn staff.
- The latex-screened zone should be decontaminated with a protein wash.
- NRL products must not be stored in the latex-screened surgery or with the NRL-free items.
- Staff should wear fresh protective clothes, and thoroughly wash hands and arms.

- Any facemasks should have paper ties.
- Have NRL-free emergency equipment at hand.<sup>16</sup>
- Discuss all aspects of treatment with the patient.
- Ensure that all personnel, for example radiographers or new staff likely to come into contact with the patient, are aware of the NRL allergy.

#### During treatment

- All equipment must be NRL-free (see Table 1).

NB: Powdered NRL gloves should not be used in a clinical environment.

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