

# IF MY HANDS COULD SPEAK

GLOVE-ASSOCIATED REACTIONS: CAUSES, SYMPTOMS AND MANAGEMENT



If our hands could speak, we might pay more attention to the condition of our

hands whilst wearing gloves. With the massive increase in glove usage (US Dept of Health & Human Services, 1997<sup>1</sup>), it may not be a surprise that the incidence of glove-associated reactions has also grown.

Coupled with increased consumption is the frequency and the duration of glove use in the workplace, both of which have increased exponentially in the last few years. Also we should not ignore the contribution of glove powder, along with constant hand washing that adds to the problem. Whether it is personal protection from chemicals and biohazards or protecting the process from contamination, gloves are our constant companion. By being aware of the causes and symptoms of glove-associated reactions, we can continue to enjoy the protective properties of

disposable gloves and undertake the necessary hand care regime to reduce the risk of such conditions developing.

Yes, but you only get it from ...

A common fallacy is that glove wearers can only experience reactions when wearing natural rubber latex gloves. All gloves, whether synthetic or natural rubber latex, have the potential to elicit reactions in some individuals. The most common reaction is non-allergic irritant contact dermatitis and can be experienced with all glove materials. Roughly 40%-60% of all glove wearers experience this condition (Owenby, 1998<sup>2</sup>), so if you use gloves regularly, the chances are you will be affected by irritant contact dermatitis. The next most common reaction is allergic contact dermatitis, which again can occur with all glove materials. However, as this is an allergy only those individuals that

have the genetic predisposition to be allergic to a certain chemical allergen are vulnerable. It is believed that some 12% (Gibbon, 2001<sup>3</sup>) of the population is potentially affected by allergic contact dermatitis. The least common reaction is natural rubber latex allergy, which is specific to the proteins found in natural rubber latex or cross-reactive plant allergens. Between 0.8% and 7% of the general population is reported to be potentially susceptible to natural rubber latex allergy (Lebenbom-Mansour, 1997<sup>4</sup>). Amongst health care workers the incidence of natural rubber latex allergy appears to be higher, with a recent study in South African hospitals reporting a prevalence of 9% to 20% (Potter, 2002<sup>5</sup>).

What are the three types of glove reactions?

As we now know, the three glove associated reactions are irritant contact ▶

dermatitis, allergic contact dermatitis and natural rubber latex allergy. Each has unique characteristics that allow for distinguishing one from the other.

## IRRITANT CONTACT DERMATITIS (also known as irritation, irritant dermatitis or dermatitis)

Irritant contact dermatitis is a non-allergic condition and may be caused by either non-glove related or glove-associated irritants. Indeed there are over 85,000 chemicals with the potential to cause irritant contact dermatitis under the right conditions (Drake, 1995<sup>6</sup>). When making an assessment of irritant contact dermatitis, it is helpful to remember that there are both non-glove-related and glove-related conditions.

### Non-glove-associated irritant contact dermatitis

Among the multitude of everyday products known to cause irritant contact dermatitis are detergents, chemicals in hand soaps, disinfectants, solvents, glues, etc. Frequent washing and drying of hands has become part of the daily regime in the workplace, but with it comes the potential to produce the right conditions for irritant contact dermatitis. In this context, scalding hot water helps to break down the natural skin barrier properties making it more vulnerable. With sudden changes in weather conditions, the skin may become chapped and more susceptible to developing irritant contact dermatitis. If you wear jewellery, irritants can build up below or around rings particularly if there is inadequate rinsing.

### Glove-associated irritant contact dermatitis

Glove-associated irritants are chemicals, powder, endotoxin, friction and air occlusion. Residual chemicals are a concern if they are not removed from the glove surface through extensive washing or processing. Powder is often used as a release agent on the ceramic moulds or to facilitate donning. It can have a drying and abrasive effect on the

hands leaving the skin vulnerable to cracking. Endotoxin is fragments from the cell wall of dead gram-negative bacteria. It is an inflammatory substance and is typically associated with irritant contact dermatitis. It is ubiquitous in nature and is not eliminated by sterilization. Endotoxin has also been reported to accelerate the rate of sensitization to allergens. Friction and air occlusion are often overlooked when considering the causes of irritant contact dermatitis. Friction happens when the glove fits too tightly and rubs continuously against the skin. Compounding this condition is long-term wet work or excessive sweating that creates a soggy condition on the skin surface, leaving the cells more vulnerable to friction and abrasive irritation.

### Symptoms of irritant contact dermatitis

Typically the onset of symptoms is evident within minutes to hours after the gloves are donned. Initial symptoms often include redness, itching and a burning sensation. In its chronic stage irritant contact dermatitis can lead to the thick, dry crusty skin, papules (small, hard bumps), blisters and sores. The accumulation of sweat next to the skin is a feature of air occlusion and can lead to another form of irritant contact dermatitis known as dyshidrosis. Here vesicular skin eruptions on the hands can eventually burst causing considerable discomfort. It is important to note that if the irritation is associated solely with the gloves, the irritant symptoms are normally confined to the area of glove contact.

### Proposed action for managing irritant contact dermatitis

- *Consult your supervisor or occupational health professional*
- *Select natural rubber latex or synthetic gloves that are low in residual chemicals and endotoxin (e.g. use gloves that have an undergone testing for irritation such as the Primary Skin Irritation Test)*
- *Wear a larger glove to increase air circulation until hands heal*
- *Change gloves more frequently to allow air to get to the hands if gloves are worn for long periods*

- *Wear powder-free gloves*
- *Implement hand care regimen, using skin creams to restore natural barrier properties of skin. However, note that petroleum-based creams may degrade natural rubber latex*
- *Wear glove liners, but be sure to replace them every time gloves are changed. Please note that glove liners do not replace hand washing.*

Whilst irritant contact dermatitis may not be a serious occupational illness, it can lead to more serious conditions. As it is difficult to adequately scrub hands that have open cracks, irritant contact dermatitis can reduce the effectiveness of hand washing. In this way, micro-organism such as staphylococcus can colonize the open lesions, thereby increasing the risk of infection. Furthermore, the rupture of the skin's natural skin barrier can facilitate the entry of allergens. In this context it has been demonstrated that latex protein penetration was 1% for those individuals without irritant contact dermatitis, but 23% for those with irritant contact dermatitis (Haye, 2000<sup>7</sup>).

## ALLERGIC CONTACT DERMATITIS (also known as type IV, Delayed Hypersensitivity or Chemical Allergy)

Only those persons who are genetically predisposed to specific chemical allergens are susceptible to experiencing an allergic response. In common with other allergies, repeated exposure to the specific allergen accelerates the sensitization process until that individual's personal threshold is reached. Once this is achieved, subsequent exposure to the allergen will trigger a reaction. Depending on allergen exposure and the genetic profile of the individual, the process of sensitization may take days, weeks, months, years or never. In common with irritant contact dermatitis, it is important to distinguish between non-glove associated and glove-associated allergic contact dermatitis. ▶

### **Non-glove-associated allergic contact dermatitis**

With more than 2,800 substances having the potential to cause allergic contact dermatitis (Drake, 1995<sup>6</sup>), it is important to take a holistic view when trying to identify the source of any dermal reaction. Consideration should be given to soaps, detergents, lotions, jewelry, nickel, fragrances, glutaraldehyde, quaternary ammonias, formaldehyde and many other substances in the workplace, home and outdoor environment.

### **Glove-associated allergic contact dermatitis**

The main agents responsible for glove-related allergic contact dermatitis are vulcanization accelerators (typically thiurams, thiazoles, dithiocarbamates etc), which are used routinely in the manufacture of natural rubber latex and nitrile gloves. However, other chemical contact sensitizers are plasticizers, stabilizers, antioxidants, biocides, preservatives, processing agents, donning agents, colorants etc.

More recently it has been discovered that allergic contact dermatitis can be derived from the latex itself, with Sommer, 2002,<sup>8</sup> reporting a prevalence

of less than 1% in a study covering 2738 patients.

### **Symptoms of allergic contact dermatitis**

Allergic contact dermatitis comes in various clinical forms, starting with an acute reaction (after an initial contact with the allergen) through to the chronic form (associated with persistent contact with the antigen). Symptoms at the early stage include redness, swelling, small blisters and itching. In its chronic form, these symptoms may be accompanied by dry, thickened skin, scaling, dryness, open lesions, development of papules, etc. Typically the onset of symptoms is 6 to 48 hours (Rietschel, 1995<sup>9</sup>). Whilst differentiating allergic contact dermatitis from irritant contact dermatitis can be difficult, it is important to remember that whilst glove-associated irritant contact dermatitis is confined to the area of glove contact (Cohen, 1998<sup>10</sup>) the symptoms of allergic contact dermatitis may extend up the arm beyond the area of glove contact.

### **Proposed action for managing allergic contact dermatitis**

As diagnosis can be difficult, patch testing may be necessary. Here a ▶



range of allergens are used covering the most frequently encountered chemical contact sensitizers e.g. vulcanization accelerators. Often a sample of both sides of the suspect glove are used in the patch test. As powder can act as a vector for chemical allergens, it is important to recognise the potential benefit of having a powder-free policy with a view to limiting allergic contact dermatitis. Other action that should be considered is as follows:

- Consult occupational health and a dermatologist if symptoms persist
- Switch to gloves documented to be low in residual chemicals and low in chemical contact sensitizers
- Select powder-free gloves only
- Wear cotton or nylon glove liners, but be sure to replace them every time gloves are changed
- If a specific chemical allergen has been identified through patch testing, switch to a glove manufactured without this chemical
- Taking into account the likelihood of non glove-related causative agents, consider alternative allergen contact avenues e.g. the accelerator thiuram is found in fungicides and adhesive materials (Taylor, 2000<sup>11</sup>)

As selecting gloves that are low in chemical contact sensitizers is important for limiting the risk of allergic contact dermatitis, request from the glove manufacturer high performance liquid chromatography (HPLC) or thin layer chromatography (TLC) test data to demonstrate that it was not possible to detect the most commonly used chemical contact sensitizers in the gloves.

To aid in determining whether the gloves have low levels of residual

chemicals, seek confirmation from the glove manufacturer that the gloves have undergone sensitization testing e.g. Buehler Test or 200 Person Modified Draize Test.

## NATURAL RUBBER LATEX ALLERGY (also known as Immediate Type Hypersensitivity, Protein Allergy or Type I)

Whilst natural rubber latex allergy is comparatively scarce, it is possibly the most feared due to its potential to cause anaphylactic shock. In common with allergic contact dermatitis, it is dose and rate dependent. Natural rubber latex allergy is an immunoglobulin E (IgE) antibody mediated allergy and only those individuals that are genetically predisposed to sensitization to a specific latex protein are vulnerable. Of the reported 250 protein peptides in raw latex, about 50 are reported to have the allergenic potential capable of inducing the production of IgE antibodies. Successive challenges by the specific latex protein allergen increases the production of IgE antibodies and leads to increasing sensitization of cells. Clinical symptoms develop when the individual's unique "symptom threshold limit" is reached. Once a person's symptom threshold level is reached, subsequent contact with the specific protein allergen causes the sensitized cells to release immunological mediators such as histamine.

When discussing the mechanism of natural rubber latex allergy, it is

important to understand the correlation between food allergies and latex protein allergies. Individuals who are allergic to food like avocados, bananas, cherries, chestnuts, kiwis, melons, peaches, pears, tomatoes etc may have a higher probability of developing a latex protein allergy. In view of the cross-reactivity between natural rubber latex protein allergens and many commonly encountered plant allergens, any individual presenting with one or more food allergies should be screened for natural rubber latex allergy. Similarly whilst the traditional sources of exposure to natural rubber latex allergy are direct skin or mucosal contact, glove powder can be an important vector for triggering reactions generated by inhalation of aerosolized allergens.

### Symptoms of natural rubber latex allergy

Once an individual's symptom threshold is reached, the onset of symptoms may occur within minutes to an hour after exposure to the allergen(s), hence the alternative name for natural rubber latex allergy of immediate type hypersensitivity (Warshaw, 1998<sup>12</sup>). The initial symptoms of natural rubber latex allergy are often itching and tingling, but with time may present in various forms and these are summarized in the table below. The potential of this reaction to exhibit systemic symptoms and progress to anaphylactic shock is unique to natural rubber latex allergy. The profile of natural rubber latex allergy is shared with penicillin, shellfish and peanut allergies.

Whilst discussing the symptoms of natural rubber latex allergy, it is noteworthy that Horn & Aldridge, 2003,<sup>13</sup> reported urticaria (typically associated with natural rubber latex allergy) when wearing nitrile gloves. ▶

General	Facial	Systemic	Respiratory
Abdominal cramps	Allergic rhinitis	Anaphylactic shock	Asthma-like symptoms
Diarrhoea	Allergic conjunctivitis	Cardio-respiratory arrest	Bronchospasm
General itching	Swelling	Dizziness	Wheezing
Hives/urticaria (anywhere)	Facial & laryngeal oedema	Hypotension	Difficulty breathing
Nausea/vomiting		Rapid heart rate	

Symptoms of natural rubber latex allergy



Further investigation revealed the causative agent as 2,2'-methylene-bis-(4-methyl-6-tert-butylphenol), an antioxidant used in the manufacture of synthetic and natural rubber latex gloves.

#### Proposed action for managing natural rubber latex allergy

The potentially serious symptoms associated with natural rubber latex means that this reaction is likely to remain in the spotlight. Reports by the TUC that natural rubber latex allergy is the third leading cause of occupational asthma in Europe (TUC Report, 2001<sup>14</sup>) and encouragement by the Health & Safety Executive to seek latex-free solutions (HSE Report<sup>15</sup>) means that this trend is likely to continue. Against this view is the increasing evidence emerging from Germany (Allmers, 2002<sup>16</sup>) and Finland (Turjanama, 2002<sup>17</sup>) suggesting that wearing low protein non-powdered natural rubber latex gloves greatly reduces the risk of allergic reactions. Likewise the comfort and barrier properties of natural rubber latex (particularly to biohazards and aqueous liquids) are well documented. However, for people in regular contact with natural rubber latex in the workplace, it should be noted that the risk of natural rubber latex allergy is likely to be higher than that for the general population. This is because repeated use of natural rubber latex gloves can

increase the risk of sensitisation. In addition, the widespread use of organic solvents in the workplace may render natural rubber latex unsuitable for use.

#### Proposed action for managing natural rubber latex allergy

- *Notify your supervisor*
- *Consult Occupational Health*
- *Avoid contact with products made from natural rubber latex (e.g. rubber bands, surgical masks, syringes, tubing etc) and wear synthetic gloves*
- *Request that individuals wearing gloves in the workplace, use only powder-free latex or synthetic gloves*
- *Notify your colleagues, GP and dentist of this allergy – wear a medic alert bracelet*
- *Learn to recognize the symptoms of natural rubber latex allergy*
- *Be aware that symptoms may develop after contact with cross-reactive allergens*

#### Other management action controlling the risk of natural rubber latex allergy

As mentioned earlier natural rubber latex gloves remain an attractive proposition in terms of comfort and cost-

effectiveness, whilst for the majority of the general population there is no risk of natural rubber latex allergy. In addition the suitability of natural rubber latex gloves will be determined by a risk-assessment. However, there are some effective measures that can significantly reduce the risk of natural rubber latex allergy:

- *Implement a powder-free work environment*
- *Source only gloves that are low in latex-protein content. Test data should be current and have been performed by a reputable independent laboratory*
- *In Europe test methodology will typically be based on the EN455-3 Modified Lowry method, which will provide total amount of protein. Given that natural rubber latex allergy is dose and rate dependent and there is a correlation between exposure levels and the speed at which one reaches the critical threshold, lower levels of latex protein can be expected to reduce the risk of developing natural rubber latex allergy. In this context, the HSE qualifies low protein natural rubber latex gloves as those with less than 50 µg/g (HSE Report<sup>18</sup>)*
- *Whilst the Modified Lowry assay appears to be the most widely recognized test for latex protein, other tests specific to latex protein exist. One such test is the ELISA Inhibition or the LEAP (Latex ELISA for antigenic*

protein) assays, which measures only latex proteins that the body can recognize (antigenic). Test results are expressed as microgram of antigenic protein per gram of glove ( $\mu\text{g/g}$ ). LEAP is now incorporated into a US standard based on ASTM D6499 "Test Method for the Immunological Measurement of Antigenic Protein in natural rubber and its products" and may provide a useful complement to the Modified Lowry method

- Natural rubber latex allergenic protein may be measured by the RAST or Radioallergosorbent Test. This is an in vitro or test tube test used to identify and quantify latex specific IgE antibodies in patient serum or latex allergens from product extracts, depending on the way in which the test is conducted

## Conclusion

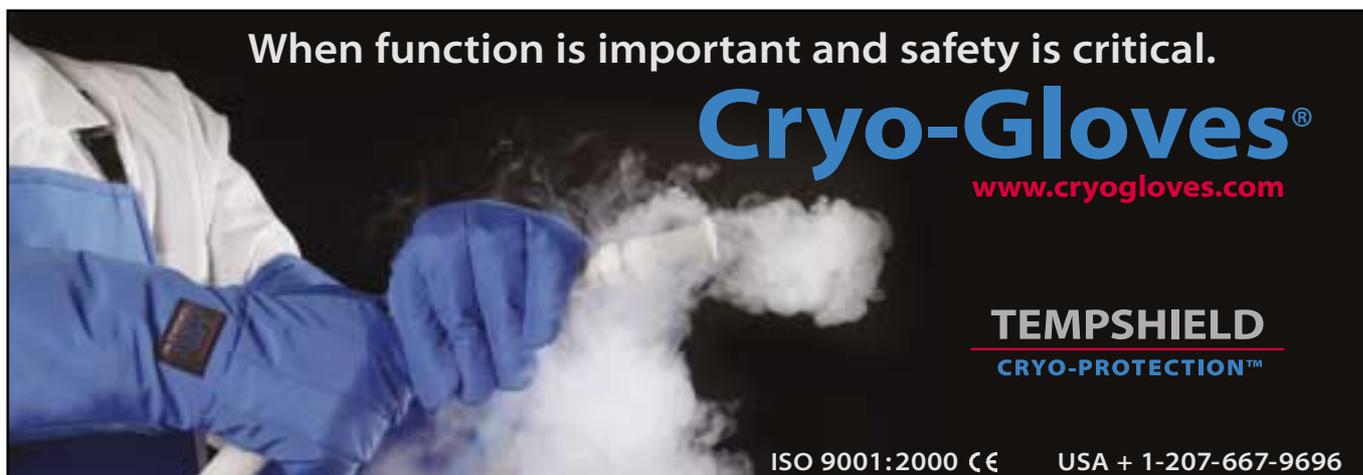
If my hands could speak, we would be more aware of the potential of our gloves to cause dermal reactions. We would also know that in the workplace there are external factors such as soaps, disinfectants, skin creams etc that can contribute to the problem. Whilst natural rubber latex allergy is potentially the most serious glove-associated reactions, the risk is restricted to natural rubber gloves and a relatively small proportion of the general population. Allergic contact dermatitis is more frequently encountered and can be triggered by all glove materials. Irritant contact dermatitis is a non-allergic condition that can affect us all and is relatively common to the extent that most of us are likely to experience this dermal reaction. Like allergic

contact dermatitis, all glove materials have the potential to elicit irritant contact dermatitis.

Whilst the increase in glove-associated reactions correlates closely with the increase in glove use, there are simple actions that we can take to reduce the risk. As the role of powder is associated with all three reactions, by introducing a powder-free work environment we have already taken an important step to managing glove-associated reactions. Glove selection on the basis of their suitability for the work we are doing or seeking gloves that have low chemical residues is also important. For natural rubber latex gloves, selecting gloves with low latex protein is crucial. ■

## References

- <sup>1</sup> US Department of Health and Human Services Center for Devices and Radiological Health. *Medical Glove Powder Report*, September 1997
- <sup>2</sup> Owenby DR. "Allergies to Natural Rubber Latex", presentation by Safeskin Corporation (Orlando, Florida, USA, 1998)
- <sup>3</sup> Gibbon K.L., McFadden J.P., Rycroft R.J. (2001, February) *British Journal of Dermatology* 144(2):347-350
- <sup>4</sup> Lebenbom-Mansour, M.H., Oesterle J.R., Owenby D.R., et al. (1997) "The of latex sensitivity in ambulatory surgical patients: a correlation of historical factors with positive serum immunoglobulin E levels" *Anesth Analg* 85:44-49
- <sup>5</sup> Potter, P.C. (2002) "Latex allergy in South Africa" *Allergy Clin Immunol Int* 14:10-12
- <sup>6</sup> Drake L.A., Dörner W, Goltz R.W. (1995) "Guidelines of care for contact dermatitis" *J Am Acad Dermatol* 32:109-113
- <sup>7</sup> Hayes B.B., Afshari A, Millechial L, Willard P.A., Povoski S.P., Meade B.J. (2000) "Evaluation of percutaneous penetration of natural rubber latex proteins" *Toxicol Sci* Aug; 56(2)
- <sup>8</sup> Sommer S, Wilkinson S.M., Beck M.H, English J.S., Gawkrödger, D.J. & Green C (2002) "Type IV hypersensitivity reactions to natural rubber latex: results of multi-centre study" *Br. J. Dermatol* Jan:146(1) pp114-117
- <sup>9</sup> Rietschel R.L., Fowler Jr JF, eds. (1995) Chapter 4: Histology of Contact Dermatitis *Fisher's Contact Dermatitis*, 4th ed. Baltimore MD: Williams & Wilkins; 1995, 38-39.
- <sup>10</sup> Cohen D.E. et al. (1998) "American Academy of Dermatology Position Paper on Latex Allergy" *Journal of the American Academy of Dermatology*; 39 (July): 98-106
- <sup>11</sup> Taylor J.S. and Leow Y.H. (2000) "Cutaneous Reactions to Rubber" *Rubber Chemistry and Technology: Rubber Reviews*. 73:3 July-August: 427-485
- <sup>12</sup> Warshaw E.M. (1998) "Latex Allergy" *Journal of the American Academy of Dermatology* July, 39:1
- <sup>13</sup> Horn H.M. and Aldridge R.D. (2003) "Contact urticaria due to nitrile gloves" *Contact Dermatitis* 49 (September) 163
- <sup>14</sup> Trades Union Council Report (2001) "Rubber banned? The case against latex" [on line], London. Available from [www.tuc.org.uk/h\\_and\\_s/tuc-3250-f0.cfm](http://www.tuc.org.uk/h_and_s/tuc-3250-f0.cfm)
- <sup>15</sup> Health and Safety Executive "I work in a laboratory" [on line]. Available from [www.hse.gov.uk/latex/labs.htm](http://www.hse.gov.uk/latex/labs.htm)
- <sup>16</sup> Allmers H., Schmengler J. and Skudlik C. (2002) "Primary Prevention of natural rubber latex allergy in the German Health Care System through education and intervention" *J. Allergy Clin. Immunol.* 110 (2):318
- <sup>17</sup> Turjanama K., Kanto M., Kautiainen H., Reunala T. and Palosuo T. (2002) "Long term outcome of 160 adult patients with natural rubber latex allergy" *J. Allergy Clin. Immunol.* 110: S70-74
- <sup>18</sup> Health and Safety Executive "About latex allergies" [on line]. Available from [www.hse.gov.uk/latex/about.htm](http://www.hse.gov.uk/latex/about.htm)



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