

Source: Journal of Dental Hygiene, Vol. 79, No. 2, Spring 2005

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## Prevalence of Type I Natural Rubber Latex Allergy Among Dental Hygienists

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***Purpose.*** Oral health care professionals have been shown to be at risk for developing a type I allergy to natural rubber latex (NRL). The objective of this study was to assess the prevalence of this allergy in dental hygienists.

***Methods.*** Participants attending the 2000-2002 American Dental Hygienists' Association (ADHA) national meetings were screened for type I allergies to NRL using skin prick testing, symptom assessment, and health history. Participants were classified as positive for a type I NRL allergy based on their positive skin prick reactions to standardized NRL solutions. Risk factors and symptom assessments were based on a self-reported health history.

***Results.*** Of the 582 ADHA participants who completed the screening and health history questionnaire, 4.8% (n=28) screened positive for a type I allergy to NRL (SPT-positive). These SPT-positive participants were significantly more likely to report an allergy to cross-reacting foods, plants, molds, and pollens, and to report reactions to rubber products. Participants screened SPT-positive were also significantly more likely to report a history of hives and respiratory symptoms after contact with natural rubber.

***Conclusion.*** Based on skin prick testing, the prevalence of a type I allergy to NRL in dental hygienists appears similar to that reported for other oral health care professionals and is greater than the general population. Educating dental hygienists about type I NRL allergy may help reduce prevalence and improve its management.

**Keywords:** Latex, allergy, rubber, dentistry, dental hygiene, occupational allergy, gloves, hypersensitivity

### Introduction

The natural rubber latex (NRL) used in health care gloves is obtained from *Hevea brasiliensis* trees.<sup>1</sup> This botanical product contains at least 13 known plant proteins that can elicit allergic reactions in susceptible individuals, in much the same way that pollen induces seasonal allergies. Allergenic plant proteins are found in latex health care gloves and latex products such as catheters, dental dams, and balloons.

While contact allergies to the chemicals in rubber have been recorded since 1927, systemic reactions to NRL were not documented until 1979.<sup>2</sup> This pivotal case report described symptoms consistent with a type I allergy, which is a systemic immune system response that can become life-threatening. Within the following decade, type I allergic reactions to NRL in both dental patients and workers had been reported.<sup>3,4</sup>

The diagnosis of a type I allergy to NRL should be based on both clinical test results and a detailed health history. Commonly accepted clinical test methods for type I NRL allergy include skin prick tests with standardized NRL solutions, or blood tests for the presence of circulating anti-NRL antibodies.<sup>5</sup> Of these, skin prick testing is generally considered the more accurate method.<sup>6</sup>

A medical and occupational history should also be obtained to determine the presence of symptoms associated with a type I NRL allergy, such as urticaria (hives) and rhinoconjunctivitis (runny nose and itchy eyes).<sup>5,6</sup> Potential risk factors should also be assessed, including recurring NRL exposure, previous reactions to rubber, multiple childhood surgeries, or treatment for myelodysplasia (e.g. spina bifida). An additional risk factor is a history of allergies to certain fruits and plants, such as avocados and kiwi, that contain proteins (panallergens) that are similar to those found in *Hevea brasiliensis*.<sup>5</sup>

Based on skin prick test results, studies estimate that between 6% and 38% of oral health care professionals may have a type I allergy to NRL proteins.<sup>7,8,9</sup> Although most research has focused on dentists, one study conducted in 1994 and 1995 noted that 9% of dental hygienists tested positive for a type I allergy to NRL.<sup>9</sup>

Our objective in the current study was to obtain a more current assessment of the prevalence of type I NRL allergy in dental hygienists, and to examine the frequency of common risk factors for type I NRL allergy in this population. Therefore, participants attending the American Dental Hygienists' Association (ADHA) annual sessions over a three-year period were screened for a type I NRL allergy using skin prick testing and a detailed health history questionnaire.

## **Materials and Methods**

Dental hygienists attending the 2000, 2001, and 2002 ADHA national meetings in Washington, D.C., Nashville, Tennessee, and Los Angeles, California, respectively, were screened for a type I NRL allergy. Voluntary participation included a self-administered four-page questionnaire and skin prick testing for a type I allergy to NRL. All participants provided written consent according to guidelines established by the Department of Health and Human Services Office for Human Research Protections.<sup>10</sup>

### ***Questionnaire***

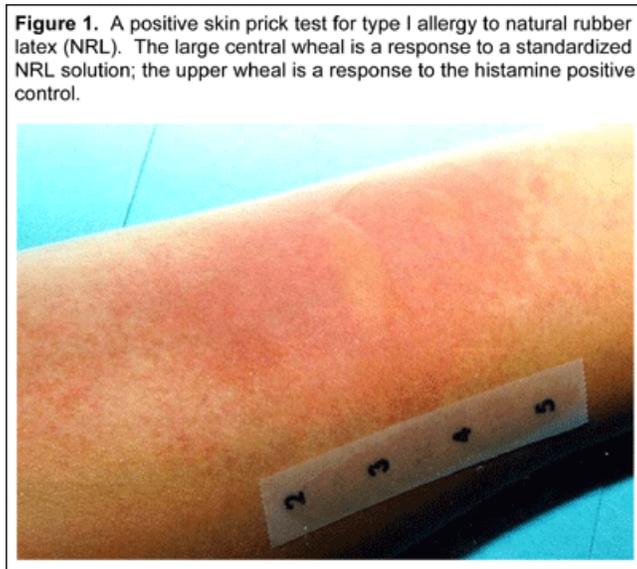
Participants received uniquely numbered questionnaires that asked questions about their occupational history, health, personal identifying data, and anthropometric data (e.g. height and weight). Participants were also asked to recall allergy symptoms and history, surgical history, known reactions to foods, medical, or household products, and any previous testing or treatment for an allergy to rubber products.

**Skin prick testing (SPT) for type I latex allergy:** Testing was performed using either a commercial NRL test solution (Stallergenes SA, France) alone (2002) or in combination with NRL glove-based solutions (2000 and 2001) prepared by the University Hospital of Tampere Dermatology Department in Finland, as described previously by Hamann et al. and Turjanmaa et al.<sup>9,11</sup> In two years of comparative studies conducted at various conferences, no differences were observed in skin prick test results between the Stallergenes commercial NRL test solution and the NRL glove solutions prepared in Tampere, Finland.

Drops of test solutions were placed on the inner forearm of each participant in the following order: 1) histamine positive control; 2) NRL test solution(s); and 3) saline negative control. The skin was pricked through each drop using separate sterile lancets (Prick Lancetter, Bayer), and the sites blotted dry with gauze. Skin prick sites were examined 15 minutes later for the presence of wheals, and their diameters were measured in millimeters. Other than localized itching, there were no adverse reactions to SPT.

Participants were considered "SPT-positive" if their type I NRL allergy test results included: 1) histamine-positive control wheal of at least three millimeters; 2) NRL test solution wheal(s) measuring at least half that of the histamine positive control; and 3) no measurable wheal for the saline negative control. Participants testing positive for a type I NRL allergy

(Figure 1) were given educational literature and management guidance and were instructed to consult their health care providers.



Participants were considered "SPT-negative" if their type I NRL allergy test results included: 1) histamine-positive control wheal of at least three millimeters; 2) no measurable wheal(s) for the NRL test solution; and 3) no measurable wheal for the saline negative control.

Participant SPT results were considered dermatographic and indeterminate if measurable wheals were present at all prick sites. Participant SPT results were considered equivocal if the histamine-positive control wheal was less than three millimeters. Equivocal reactions usually occurred in participants who exceeded the 15-minute test period time or had taken antihistamines in the last 24 to 48 hours. Participants with dermatographic or equivocal reactions were instructed to contact their allergist or dermatologist for additional testing.

### **Statistics**

Data was entered and sorted with Access (Microsoft, Redmond, WA). Data tables were imported into the Statistical Package for Social Scientists (SPSS, Inc.; Chicago, IL), which was used for determination of means, standard deviations, frequencies, t-tests, and Pearson chi-square analysis.

### **Results**

A total of 631 ADHA conference attendees participated in this type I NRL allergy screening during the three-year study. Of these, 582 participants completed the questionnaire and reported practicing, studying, or teaching dental hygiene; 49 did not identify themselves as associated with the dental hygiene field and were therefore excluded from the data set. Participants were generally female (98%) around 40 years of age (Table I) and identified themselves as one of the following categories of dental hygiene professionals: dental hygienists (86%), dental hygiene students (10%), dental hygiene program instructors (2.7%), and dental hygiene program administrators (0.7%). Most reported working in general dentistry practices full-time (approximately 30 hours per week and at least 44 weeks per year).

**Table I.** Self-reported demographics of participants (total n= 582) in type I NRL allergy screenings conducted at ADHA conferences.<sup>1</sup>

	<b>2000</b>	<b>2001</b>	<b>2002</b>
<b>Total screened participants working in dental hygiene<sup>2</sup></b>	240	224	118
<b>Female gender</b>	99% (n=237)	98% (n=219)	100% (n=118)
<b>Average age (years)</b>	44.4 ± 10.8 (n=227)	39.4 ± 11.2 (n=201)	44.3 ± 11.0 (n=110)
<b>Total years in practice</b>	18.7 ± 11.5 (n=235)	15.3 ± 11.4 (n=204)	20.6 ± 11.3 (n=105)
<b>Hours worked per week</b>	31.4 ± 10.4 (n=235)	30.4 ± 11.4 (n=204)	29.0 ± 10.7 (n=105)
<b>Weeks worked per year</b>	44.3 ± 10.8 (n=235)	44.3 ± 12.3 (n=204)	47.6 ± 29.3 (n=105)

<sup>1</sup> Note that the n-value shown in parentheses is the number of individuals responding to each question and may be less than the total number of screening participants.

<sup>2</sup> Participants identified themselves as working in the field of dental hygiene and included dental hygienists, dental hygiene students, instructors, and school administrators.

Of the 582 ADHA participants that identified themselves as belonging to one of the above dental hygiene professional categories, 28 (4.8%) tested positive for a type I NRL allergy (SPT-positive). The prevalence of type I NRL allergy appeared to decrease over time, and was less in 2002 (3.4%) than in 2000 (5.4%), as shown in Table II.

**Table II.** Annual skin prick test results<sup>1</sup> for participants screened for a type I NRL allergy at ADHA conferences.

	<b>2000</b>	<b>2001</b>	<b>2002</b>
<b>SPT-positive participants</b> (total n=28)	5.4% (n=13)	4.8% (n=11)	3.4% (n=4)
<b>Participants with an equivocal or dermatographic test result<sup>2</sup></b> (total n=5)	0.8% (n=2)	0.9% (n=2)	0.8% (n=1)
<b>Number of participants screened</b> (total n=582)	240	227	118

<sup>1</sup> Skin prick test results were classified according to wheal size per standardized testing as described in the Materials and Methods section.

<sup>2</sup> Participant skin prick test results were not interpretable due to dermatographism, late reading, insufficient response, or interference from drugs such as antihistamines.

Incidence could not be assessed due to the small number of participants (identified by name, date of birth, and height) screened at multiple conferences. Only four individuals were screened at all three conferences, while nine individuals were screened at both the 2001 and 2002 conferences; all tested negative. Nineteen participants were screened at both the 2000 and 2001 conferences; only one participant tested SPT-positive, and only in 2000.

Participants were generally healthy. Only 17% (97 of 571 respondents) reported having one of the following health conditions: diabetes, stroke, kidney disease, liver disease, rheumatoid arthritis, multiple sclerosis, alcoholism, and high blood pressure. However, a history of allergies or allergic reactions was more common. Hay fever, asthma, eczema, or contact dermatitis was reported in 46% (n=262) of participants. Reactions to foods, medications, plants, insects, chemicals, and dental materials were noted by 74% (n=435 of 582) of participants.

Participants that screened SPT-positive were more likely to report some history of allergies or allergic reactions (Table III). Significantly more SPT-positive participants reported a history of asthma as compared to those who screened SPT-negative. In contrast, SPT-positive participants reported symptoms of hay fever, eczema, or contact dermatitis slightly more frequently than SPT-negative participants, and this difference was not significant. Overall, 28% of study participants

noted some reaction to consumer, medical, or dental rubber products. These reactions were reported significantly more often in SPT-positive participants (Table III).

**Table III.** Self-reported allergies and allergic reactions in ADHA conference participants who screened positive or negative for a type I NRL allergy.

<b>Participants reporting <sup>1</sup>:</b>	<b>SPT-Positive (n=28)</b>	<b>SPT-Negative (n=549)</b>
<b>History of asthma</b>	29% <sup>2</sup> (n=8)	12% (n=66)
<b>History of hay fever, eczema, or contact dermatitis (i.e. other allergies)</b>	50% (n=14)	42% (n=231)
<b>Reactions to cross-reacting molds, ragweed, trees, or grasses</b>	46% <sup>2</sup> (n=13)	27% (n=149)
<b>Reactions to cross-reacting fruits and plants (kiwis, bananas, peaches, passion fruit, chestnuts, avocados, potatoes, or ficus plants)</b>	11% <sup>2</sup> (n=3)	3% (n=18)
<b>Reactions to dental, medical, or consumer rubber products</b>	46% <sup>2</sup> (n=13)	28% (n=153)

<sup>1</sup> Note that the n-value shown in parentheses is the number of individuals responding affirmatively and screening either positive or negative.

<sup>2</sup> Significant (p [ .05) association between SPT-positive screening result and self-reported allergic reactions based on Pearson's chi-square statistics.

Positive reactions to NRL panallergens were reported more frequently by SPT-positive participants (Table III). Significantly more SPT-positive participants reported allergic reactions to cross-reacting botanicals such as molds, ragweed, trees, and grasses when compared to SPT-negative participants. Similarly, reactions to kiwis, bananas, chestnuts, avocados, potatoes, or ficus houseplants were reported significantly more often in SPT-positive participants as compared to SPT-negative participants.

Of the SPT-positive participants, 46% (n=13 of 28) reported having some type of symptom after contact with NRL, as compared to 32% of SPT-negative (n=176 of 549) participants. Of the symptoms listed, respiratory problems and hives were reported significantly more often in SPT-positive participants than in SPT-negative participants (Table IV). While both SPT-positive and SPT-negative participants reported skin symptoms ranging from itching to contact dermatitis after contact with NRL, differences between these groups were not significant.

**Table IV.** Symptoms experienced after contact with natural rubber as reported by participants screened for a type I NRL allergy at annual ADHA conferences.

<b>Participants reporting <sup>1</sup>:</b>	<b>SPT-Positive (n=28)</b>	<b>SPT-Negative (n=549)</b>
<b>Respiratory symptoms: rhinoconjunctivitis, bronchospasm, runny nose, or red itchy eyes</b>	18% <sup>2</sup> (n=5)	4% (n=21)
<b>Hives</b>	25% <sup>2</sup> (n=7)	4% (n=22)
<b>Skin itching, cracking, or burning</b>	39% (n=11)	26% (n=142)
<b>Skin rash or contact dermatitis</b>	36% (n=10)	22% (n=122)

<sup>1</sup> Note that the n-value shown in parentheses is the number of individuals responding affirmatively and screening either positive or negative.

<sup>2</sup> Significant (p [ .05) association between SPT-positive screening result and self-reported allergic reactions based on Pearson's chi-square statistics.

SPT-positive participants reported experiencing symptoms for a significantly longer period than SPT-negative participants (11 +/- 5 years vs. 7 +/- 5 years; p < .05). Of these symptomatic SPT-positive participants, 54% (n=7 of 13) indicated that they had reported their symptoms to a physician. By comparison, 44% (n=77 of 176) of symptomatic SPT-negative participants noted that they had reported their symptoms to a physician.

## **Discussion**

The first accounts of type I NRL allergy in dentistry appeared in the 1980s and involved both an oral health care professional and a patient's reaction to a rubber dam.<sup>2,3,12</sup> In the mid-1990s, the prevalence of type I NRL allergy averaged 9% in 329 dental hygienists and assistants, based on skin prick test methods similar to those used in the current study.<sup>9</sup> More recent studies suggest that the overall prevalence of type I NRL hypersensitivity in medical and dental workers is decreasing.<sup>13,14,15,16</sup> Results from the current study are consistent with this trend and suggest a 5% prevalence of type I allergy to NRL in dental hygienists.

Screening for a type I allergy to NRL was conducted by skin prick testing with non-ammoniated NRL commercial test solution (Stallergenes, Antony, France) alone or in combination with specially prepared extracts from high-antigen level latex gloves (K. Turjanmaa; Tampere, Finland). During the two years in which glove extracts and ammoniated NRL standard were used simultaneously on participants, no difference in test results were observed. Both skin prick reagents have a specificity reportedly near 100%, and sensitivity ranging from 90% to 98%.<sup>5,11</sup> Therefore, the probability of a false positive result would be nearly zero, and that of a false negative result would be less than 10%.

This study's cross-sectional design is limited in that it describes the prevalence of a type I NRL allergy in a specific (and self-selected) test population. Because a broader population of dental hygienists was not randomly sampled or screened, it is unknown whether the test population accurately represents dental hygienists overall. The effect of potential selection bias cannot be excluded. In other words, it is possible that participants with symptoms were more likely to be screened, which could have over-estimated prevalence. However, because another test (carpal tunnel syndrome screening) was also offered in conjunction with allergy testing, this may have mitigated a participant selection bias. Conversely, potential participants may have avoided the allergy screening because they were already diagnosed with a latex allergy or were symptomatic and fearful about the occupational ramifications of a positive screening. This latter rationale is supported by the observation that SPT-positive participants waited a significantly longer time to report their symptoms to their health care providers. If symptomatic participants avoided the allergy screening, this would underestimate prevalence.

Participants who screened positive for type I allergy to NRL were more likely to self-report known risk factors, such as a history of asthma and allergic reactions to rubber products, certain plants, and foods. This is likely related to the presence of similar allergenic proteins (panallergens) in NRL and certain fruits, grasses, weeds, trees, and house plants.<sup>17</sup> These findings are consistent with other studies of concomitant allergies and risk factors in type I NRL allergic health care workers.<sup>17</sup>

Four times as many ADHA participants thought they had a "latex allergy" than were actually SPT-positive (19% versus 4.8%). This belief was frequently based on non-specific itching or burning after contact with latex. However, skin reactions are not indicative of a type I NRL allergy. As shown in Table IV, hives and respiratory symptoms were more significantly associated with a type I NRL allergy than itching and burning. Obtaining an accurate diagnosis is essential to prevent oral health care professionals (and their health care providers) from mismanaging their occupational skin disease.<sup>18</sup>

Although participants reported experiencing symptoms after contact with natural rubber for an average of seven years, many had not obtained medical evaluation and treatment. This observation is consistent with other occupational health studies indicating that a health care worker's skin disease can remain undiagnosed and poorly managed for an average of three years.<sup>16,19</sup> The resulting chronically broken skin can permit pathogen and allergen penetration, as well as proliferation of resident and non-resident microflora.<sup>20,21</sup> Unmanaged skin disease has resulted in transmission of hepatitis and HIV in a health care worker.<sup>20</sup>

Participants that screened SPT-positive were instructed to be aware of potential NRL allergen sources and to take steps to avoid exposure. Successful management is based on avoiding NRL allergen sources because there is no "cure" or immunotherapy treatment for type I NRL allergy.<sup>6</sup> To reduce their personal exposure, SPT-positive dental hygienists should wear only gloves made of synthetic non-latex materials such as nitrile, neoprene, polyvinyl chloride (PVC or vinyl), or polyurethane. These synthetic non-latex gloves do not contain NRL proteins. Therefore, they can be powdered or

powder-free because the source of a type I allergy is the NRL protein, not the bioabsorbable cornstarch used as a donning agent.

Oral health care professionals are also exposed to NRL protein aerosolized from powdered latex gloves worn by their coworkers. When powdered latex gloves are donned or removed, the NRL-laden cornstarch powder released becomes an airborne carrier of NRL proteins. Particles contaminated with NRL proteins have been identified in dental office carpet, furniture, cabinetry, and air handling systems.<sup>22</sup> To reduce NRL protein contamination of dental office environments, coworkers of SPT-positive dental hygienists should wear latex gloves with a low NRL protein content that are also powder free.<sup>6</sup> Alternatively, coworkers can wear synthetic non-latex gloves (with or without powder). The overall goal in any environment with NRL-allergic workers is to lower airborne NRL protein levels to less than 10 ng/m<sup>3</sup>, per the recommendations of several investigators.<sup>17,22</sup>

In addition, dental practices should develop NRL allergy management protocols, as recommended by the Centers for Disease Control and Prevention, American Dental Association, and National Institute for Occupational Safety and Health.<sup>23,24,25</sup> These allergy management protocols should include: 1) steps to evaluate both staff and patients for their risk of a type I NRL allergy, 2) measures for identifying, substituting, and isolating products that contain NRL, 3) special NRL-allergic patient management regimens, 4) education about type I NRL allergy, and 5) emergency preparedness for adverse patient or dental worker reactions, should they occur.<sup>26</sup>

## **Conclusion**

Based on this cross-sectional study, approximately 5% of dental hygiene professionals may have a type I NRL allergy. This prevalence may be greater than that observed in the general population, but it appears to be decreasing. Further research is required to determine if the downward trend observed during the three-year study period continues. Type I NRL allergic dental hygienists were also likely to report a history of reactions to foods, plants, and rubber products known to contain natural rubber. These individuals were also more likely to report a history of hives and respiratory symptoms. Type I NRL allergic individuals may delay effective diagnosis and management due to misinformation, fear, or preconceptions. Therefore, oral health care professionals should be educated about proper skin care, NRL allergens and allergy management, and should be encouraged to obtain an accurate diagnosis for any recurring symptoms of occupational skin disease.

## **Acknowledgements**

## **Notes**

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