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Occupation-related allergies in dentistry

CURTIS P. HAMANN, M.D.; LOUIS G. DEPAOLA, D.D.S., M.S.; PAMELA A. RODGERS, Ph.D.

During a routine gynecologic-related examination, a 39-year-old dentist experienced an anaphylactic reaction to an unknown allergen, which later was identified as natural rubber latex (NRL) protein. Published in 1987, this report of a “latex allergy” in a dental care professional brought the issue to the attention of the dental profession.¹ Now known clinically as a type I (immediate) NRL protein allergy, this immune response is mediated by

circulating anti-NRL antibodies (that is, it is immunoglobulin E-mediated).²

Reducing exposure to potential irritants and allergens and educating personnel about proper skin care are essential.

One of the more common symptoms of a type I NRL protein allergy is rhinoconjunctivitis, or a runny nose and itchy eyes (Table 1).³ Hives, another common symptom, can erupt locally (contact urticaria) or over the entire body (generalized urticaria).^{4,5} With continued exposure to NRL, elicited symptoms may become more severe, involving respiratory or cardiovascular systems and possibly anaphylactic shock (Table 1).²

During the 1990s, the prevalence of type I NRL protein allergy in dental and medical personnel reportedly ranged between 12 and 17 percent.^{6,7} The international attention that this problem received prompted regulatory and manufacturing changes in rubber products, increased worker awareness and encouraged new diagnostic and management strategies. As a result, the prevalence of type I NRL protein allergy in health care workers has diminished and now may be less than

Background. Allergies to natural rubber latex (NRL) were unknown in dentistry until 1987. That changed with the publication of a report documenting NRL-based anaphylaxis in a dental worker. This case and others prompted regulatory and manufacturing changes in rubber products and increased awareness throughout the profession. However, other common dental chemicals cause allergic reactions and irritation and often are handled with insufficient precautions. Although recognition of NRL allergy has improved, awareness of other potential allergens and irritants in dentistry still is limited.

Overview. Recent research indicates that the prevalence of NRL protein allergy may be decreasing. In contrast, occupation-related dermatoses associated with other dental products may be more common. Encounters with bonding agents, disinfectants, rubber, metals and detergents can cause occupation-based irritant contact dermatitis and allergic contact dermatitis. These conditions may be found in more than one-quarter of dental and medical personnel. Therefore, dental-specific information about the recognition and management of allergic and irritant reactions is needed.

Conclusions and Clinical Implications. The prevalence of occupation-related dermatitis may be increasing in dentistry. Reducing exposure to potential irritants and allergens and educating personnel about proper skin care are essential to reversing this trend.

Key Words. Allergies; dentistry; dermatitis; latex; glutaraldehyde; maethacrylates.



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TABLE 1

| KEY CHARACTERISTICS OF OCCUPATION-RELATED ALLERGIES IN DENTISTRY. | | | |
|---|---|---|--|
| CHARACTERISTIC | TYPE OF OCCUPATION-RELATED ALLERGY OR DERMATITIS | | |
| | Type I (Immediate) Allergy to NRL* | Type IV (Delayed) Allergy or Allergic Contact Dermatitis | Irritant Contact Dermatitis |
| Immune System Involvement | Systemic; immunoglobulin E-mediated reactions | Localized; T-cell mediated | Localized inflammation; no immune system involvement |
| Location of Reaction | Over entire body, owing to circulating antibodies | On skin; usually confined to contact area [†] | On skin; confined to contact area |
| Sources of Potential Allergens or Irritants in Dentistry | Plant-based proteins in NRL products | Chemicals such as natural and synthetic rubber processing chemicals, glutaraldehyde, methacrylates; some small proteins | Chemicals such as detergents, acids, alkalis, oils and solvents; continual work in abrasive, caustic or wet environments |
| Potential Risk Factors | <ul style="list-style-type: none"> ■ Allergic reactions to kiwis, bananas, avocados, chestnuts, tomatoes and potatoes, as well as to timothy grass, birch tree and weed pollens ■ Allergic reactions to latex balloons, condoms, gloves and natural rubber products ■ History of allergies (atopy), skin reactions or eczema ■ History of myelomeningocele (spina bifida) or multiple childhood surgeries ■ Regular and repeated occupational or recreational exposure to latex products | History of allergies (atopy), skin reactions, eczema or dermatitis | <ul style="list-style-type: none"> ■ History of allergies (atopy), skin reactions, eczema or dermatitis ■ Female sex ■ Age ■ Ethnicity |
| Exposure | Skin, mouth, nose, lungs, intravenous or surgical sites | Skin or mucosal contact | Skin or mucosal contact |
| Initiation of Symptoms | Within minutes or hours of contact | Within hours or days of contact | Within minutes or hours of contact |
| Cessation of Symptoms | After a few hours of contact | After a few weeks of contact | Soon after irritant is removed |
| Symptoms | <p>Skin: Hives, swelling, burning, tightness, itching, redness, tingling</p> <p>Lungs: Asthma, wheezing, bronchospasm, coughing, sneezing, rhinitis, angioedema</p> <p>Other: Nausea, vomiting, diarrhea, cramps, hypotension, tachycardia, anaphylactic shock</p> | <p>Skin: Soreness, itching, cracking, peeling, scabbing, crusting, papules, drying, swelling, thickening, redness, scaling, vesicles[†]</p> | <p>Skin: Soreness, burning, stinging, redness, swelling, blisters</p> |

* NRL: Natural rubber latex.
[†] Although less common, respiratory symptoms may occur if the allergen is inhaled.

10 percent.^{8,9}

In addition to type I allergy reactions, some studies report that certain NRL proteins can induce symptoms of allergic contact dermatitis (ACD).¹⁰⁻¹² Known clinically as a type IV (delayed) allergy, ACD reactions also are immune system-mediated (Table 1). But in contrast to the sys-

temic nature of type I allergy reactions, ACD depends on a complex interaction of T cells (specialized lymphocytes) with epidermal and dermal cells.¹³ Reactions are limited to the area contacted by allergens, which usually are chemicals and smaller proteins.

Recent laboratory studies indicate that NRL

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TABLE 2

| POSSIBLE CONTACT ALLERGENS IN DENTAL AND CONSUMER PRODUCTS.* | | | | |
|--|----------------------|------------------------|----------------|--------------------------------------|
| DENTAL OR CONSUMER PRODUCT | RUBBER CHEMICALS | | GLUTARALDEHYDE | ACRYLATES (METHACRYLATES AND OTHERS) |
| | Thiuram or Carbamate | Mercapto-benzothiazole | | |
| Adhesives, Tapes and Glues | X | | | X |
| Antiseptics | | | | |
| Artificial Fingernails | | | | X |
| Resin-Based Composites | | | | X |
| Dental Bonding Agents | | | | X |
| Disinfectants | X | | | |
| Equipment Sterilizing Solutions (such as Cidex,† ProCide‡ or Metricide‡) | | | X | |
| Fungicides, Herbicides and Insecticides | X | X | | |
| Natural and Synthetic Rubber Products: Dental Dams, Prophylaxis Cups, Mixing Bowls, Handles, Aprons, Tubing, Gas Mask, Tourniquet, Stethoscope, Earphones, Rubber Bands, Electrical Cords, Erasers, Balloons, Pads | X | X | | |
| Skin Care Products: Soaps, Lotions, Creams and Moisturizers | X | | | |
| Rubber Gloves (Medical and Utility) | X | X | | |
| Radiographic and Photo Chemicals | | | X | |

* This table includes several examples but is not intended to be all-inclusive. Dental care professionals and physicians should verify all product content with manufacturers or distributors and obtain written documentation of it from them.
 † Manufactured by Advanced Sterilization Products of Johnson & Johnson, Irvine, Calif.
 ‡ Manufactured by Kerr, a subsidiary of Sybron Dental Specialties, Orange, Calif.

proteins can induce ACD in epidermal cells and stimulate subsequent production of NRL-specific antibodies.^{14,15} Unfortunately, diagnosing NRL protein-related ACD is complicated by the lack of standardized test materials, symptoms that overlap with contact urticaria and irritant reactions, and incomplete antigen identification.^{11,16} ACD resulting from exposure to NRL proteins is considered uncommon, having been found in only 1 percent of 2,738 patch-tested subjects in a multicenter British study.¹¹

Reactions to other allergens are common in dentistry; many of them can be categorized as ACD resulting from exposure to dental chemicals.^{17,18} These dental chemicals include glutaraldehyde, methacrylates, epoxy resins, metals, antimicrobials and the processing chemicals found in NRL and synthetic rubber gloves (Table

2).¹⁹⁻²⁴ Research suggests that as many as 33 percent of allergy-tested dental workers have occupation-based ACD.^{4,17} If so, this type of occupational skin disease is more prevalent than allergic reactions attributable to NRL protein.¹⁰

In contrast to ACD, exposure to some substances can traumatize skin physically, chemically or mechanically, resulting in irritant contact dermatitis (ICD).²⁵ This inflammatory response is nonspecific and not immune system-mediated (Table 1). Symptoms generally are confined to the area of contact and can appear within minutes (acute ICD) or after several hours (delayed ICD).²⁵ ICD is diagnosed by excluding other possible sources of skin disease, such as ACD.²⁵ However, the similarity in symptom expression often makes ICD difficult to distinguish (Table 1). Common irritants reported in dentistry include gloves, don-

ning powder, glutaraldehyde, phenol, alcohols and solvents, epoxy resins, bleach, soaps, and harsh acidic or alkaline chemicals. The reported prevalence of ICD in dental workers ranges from 12 to 67 percent, similar to that in other health care workers.^{4,5,10,19}

Paradoxically, information about common ACD and ICD reactions appears less often than information regarding allergic reactions to NRL protein. This lack of awareness may have played a role in establishing the prevalence of contact dermatitis at nearly one-third of all occupation-related disease in the United States.²⁶ Estimated annual costs of contact dermatitis may exceed \$1 billion in the United States, excluding the millions of dollars spent for over-the-counter and prescription skin therapeutics, as well as the thousands of dollars spent treating diseases transmitted through cracked and abraded skin.^{26,27}

Because there is no cure for occupational allergies except avoidance, education to improve awareness and understanding of these conditions should be part of dental care training. At-risk dental personnel should be screened for potential allergies, and symptomatic personnel should be diagnosed accurately. Those who have allergies then can implement strategies for avoiding allergens or irritants. Overall, dental professionals should learn about proper skin care, potential sources of allergens and irritants, and various methods of mitigating exposure. The goal of this article is to briefly review these key issues and, ultimately, to improve the dermatologic health of dental professionals.

RISK ASSESSMENT

Dental care worker susceptibility. A person's susceptibility to allergens or irritants can play a role in the development of type I NRL protein allergy, ACD or ICD.^{7,28} The presence of existing allergies, contact dermatitis, eczema and poor skin condition may suggest an increased overall susceptibility for allergies.^{6,7} A person's age and sex can suggest increased allergen exposure, which affects his or her risk of developing ICD and ACD.^{25,29} Understanding daily activities, the frequency of wet work and potential contact with allergens also is crucial. These contributing factors all are important considerations in evaluating dental workers for their risk of occupational allergies.

Allergies to certain fruits, grasses and pollens (Table 1) frequently are associated with a type I

NRL protein allergy.^{6,7} This is because of the presence of structurally similar allergenic proteins, or panallergens, in these plants, fruits and NRL.³⁰ A history of allergies, allergic reactions and eczema also is associated with increased risk for type I NRL protein allergy.⁷ Other major risk factors include multiple childhood surgeries and myelomeningocele (spina bifida), owing to the repeated percutaneous exposure to NRL protein during critical periods of immune system development.^{31,32}

Exposure to NRL proteins. Exposure to NRL proteins can occur through the skin's coming in contact with the water-soluble proteins on the surface of NRL gloves.³³ The respiratory tract also is exposed via the NRL proteins bound to respired glove powder.^{34,35} At least 20 percent of aerosolized glove powder—cornstarch particles—are respirable, and they carry NRL allergens to the respiratory tract.^{35,36} In addition, new research suggests that cornstarch particles alone may exacerbate lung inflammatory and immune responses.^{37,38} NRL protein-laden glove powder also can contaminate skin and other environmental surfaces, furthering worker exposure.³⁹ Fortunately, with reductions in NRL glove protein and powder levels, glove-based aerosol exposure and its concomitant symptoms appear to be decreasing.^{3,8,40}

Exposure to contact allergens and irritants. Dental professionals' skin is exposed during the use of dental antiseptics, adhesives, disinfectants, resins, bonding agents, sealants, metals, medicaments and rubber gloves (Table 2). The latter frequently contain residual processing chemicals known as vulcanization accelerators and antidegradants, including thiurams, carbamates and mercaptobenzothiazoles.⁴¹ Residual levels of these compounds in gloves apparently have decreased, corresponding to a reduction in the prevalence of ACD resulting from exposure to these substances.^{23,42} However, a significant percentage (9-12 percent) of allergy-tested health care professionals remain allergic to rubber processing chemicals.^{10,24}

Methacrylates, such as 2-hydroxyethyl methacrylate and bisphenol-A glycidyl methacrylate are considered potent contact allergens.⁴³ These compounds are found at 50 to 90 percent concentration in uncured dental adhesives, bone cement and some artificial nail glues (Table 2).⁴⁴ Uncured methacrylates also can vaporize, thereby irritating and sensitizing the respiratory tract, as

well as eliciting symptoms in allergic dental workers.^{21,45} This allergy is increasingly prevalent: some studies have reported that more than 20 percent of allergy-tested dental care workers are sensitized to methacrylates.^{4,19}

Both the skin and respiratory tract of dental care workers can be exposed to glutaraldehyde-based disinfectants used in the dental office (Table 2).⁴⁶ This substance is a potent irritant and contact allergen even at concentrations as low as 0.5 percent and less than 1 part per million in air.^{46,47} A recent study reported that nearly 11 percent of allergy-tested dental personnel were allergic to glutaraldehyde.²⁰ Other common antimicrobials that are potentially irritating or allergenic include cresol, formaldehyde, mercury derivatives, quaternary ammonium compounds, phenols, chlorhexidine, alcohols and hexachlorophene.^{17,19}

Dental care workers can be exposed to allergens and irritants such as metals (such as nickel, gold, palladium and mercury), essential oils (such as eugenol), preservatives (such as thimerosal), antibiotics, anesthetics, detergents and surfactants (such as sodium lauryl sulfate), as well as other caustic chemicals (such as phenol).^{17,19,48} The prevalence of allergic or irritant reactions may depend on both occupational and nonoccupational exposure, because many compounds also are found in over-the-counter products. In addition, skin that is broken or in poor condition can increase the risk of exposure to allergenic chemicals and proteins.³³

THE DIAGNOSIS

Making an accurate diagnosis can be challenging and depends on accurate interpretation of symptoms and tests (Figure 1). Sadly, health care workers have reported having skin dermatoses for an average of three years before locating a physician with sufficient skill and experience.^{5,49} Experienced dermatologists or allergists—and sometimes both—are required; allergists are likely to test for a type I NRL protein allergy, while dermatologists commonly test for ACD.⁵⁰⁻⁵²

Symptom interpretation. Some symptoms of a type I NRL protein allergy, ACD and ICD can appear similar, such as skin and respiratory reactions (Table 1). But many symptoms can help physicians identify suspect allergens; docu-

menting these can be a first step in resolving occupational skin disease. Therefore, dental personnel should record skin reactions such as those described in Figure 2 (page 506) and Table 1. If possible, they should note the location (for example, fingertips, top of hands), frequency of occurrence (daily, occasionally) and duration (in minutes, hours or days) of these reactions.

Reactions such as hives (localized or systemic) and difficulty in breathing should be reported to a physician immediately. The physician (or the patient) should document when, where and how frequently these reactions occur. Activities seemingly associated with these skin or respiratory symptoms should be noted. For example, dental care workers handling or using disinfectants or bonding agents may report burning sensations or asthmalike respiratory reactions.⁴⁵

Activities outside work that evoke similar reactions or exacerbate symptoms should be noted. Typical examples would be skin reactions to rubber utility or sport gloves, elastic in clothing, food and plants, or gardening chemicals, as well as over-the-counter soaps, lotions and shampoos. Dental and consumer product information such as material safety data sheets (MSDSs), product inserts and labels also can provide clues to allergen content and exposure. Although not definitive, these details can help the allergist or dermatologist identify potential allergens for subsequent testing.

Many workers are tempted to self-assess symptoms or assume they have a latex allergy. This is problematic, however. Studies have shown that nearly one-quarter of workers diagnosed with type I NRL allergy report no recognizable symptoms.^{53,54} In addition, more dental care workers suspect that they have an allergy to NRL than actually test positive for such an allergy.⁵³

Diagnostic testing for a type I NRL protein allergy. Methods of detecting allergy to type I NRL proteins are based on detecting circulating antibodies to NRL proteins. They include either skin-prick testing (SPT) with a standardized source of NRL or serologic (blood) assays.^{55,56} Easy to perform, SPT is highly sensitive and generates results quickly (Figure 1). Unfortunately, commercial NRL standards for SPT are not readily available in the United States, and most glove-

Health care workers have reported having skin dermatoses for an average of three years before locating a physician with sufficient skill and experience.

based solutions prepared by physicians are poorly standardized. As a result, many physicians prefer to use serologic (blood) tests (such as Pharmacia CAP [Pharmacia Diagnostics, Kalamazoo, Mich.], DPC ALSTAT Immunoassay Kit [Diagnostic Products, Los Angeles] and Hycor HyTEC [Hycor Biomedical, Garden Grove, Calif.]). While convenient, these methods are not as sensitive as SPT and have higher rates of false negative (25 percent) and false positive (15 percent) results.⁵⁵⁻⁵⁷

In general, test results that are equivocal, or are inconsistent with a dental care worker's symptoms or history, should be repeated or confirmed by means of SPT or provocation tests.⁵⁵ (Provocation testing, also known as "use testing" or "challenge testing,"

exposes the patient to a known NRL source, such as a powdered high-protein latex glove.) Provocation testing is advisable only in controlled clinical laboratory environments that also are equipped to treat potential adverse patient reactions.

Diagnostic patch testing for ACD. Diagnosing ACD requires patch testing, which is conducted using a series of standardized chemical allergens applied to the upper back or forearm (Figure 1). Patches typically are applied for 36 to 48 hours; then they are removed and the skin is examined at 30 minutes and one, two and five days after patch removal.⁵⁸ Red and inflamed skin under a patch suggests an allergy to the applied chemical allergen. Dental personnel should be

tested with the standard series of contact allergens (such as medicaments, preservatives, rubber processing chemicals), as well as dentistry-specific contact allergens such as glutaraldehyde, methacrylates, amalgam, mercury, palladium, gold, eugenol and benzoyl peroxide.^{17,58}

Patch testing for ACD resulting from exposure to contact allergens can be invaluable, and overall, results will be accurate 70 to 80 percent of the time.⁵⁹ Test accuracy can vary with allergen, test system, skin condition, test duration and the physician's experience. When conducted according to recommended guidelines and interpreted in the context of clinically relevant symptoms, patch testing is essential in diagnosing occupation-

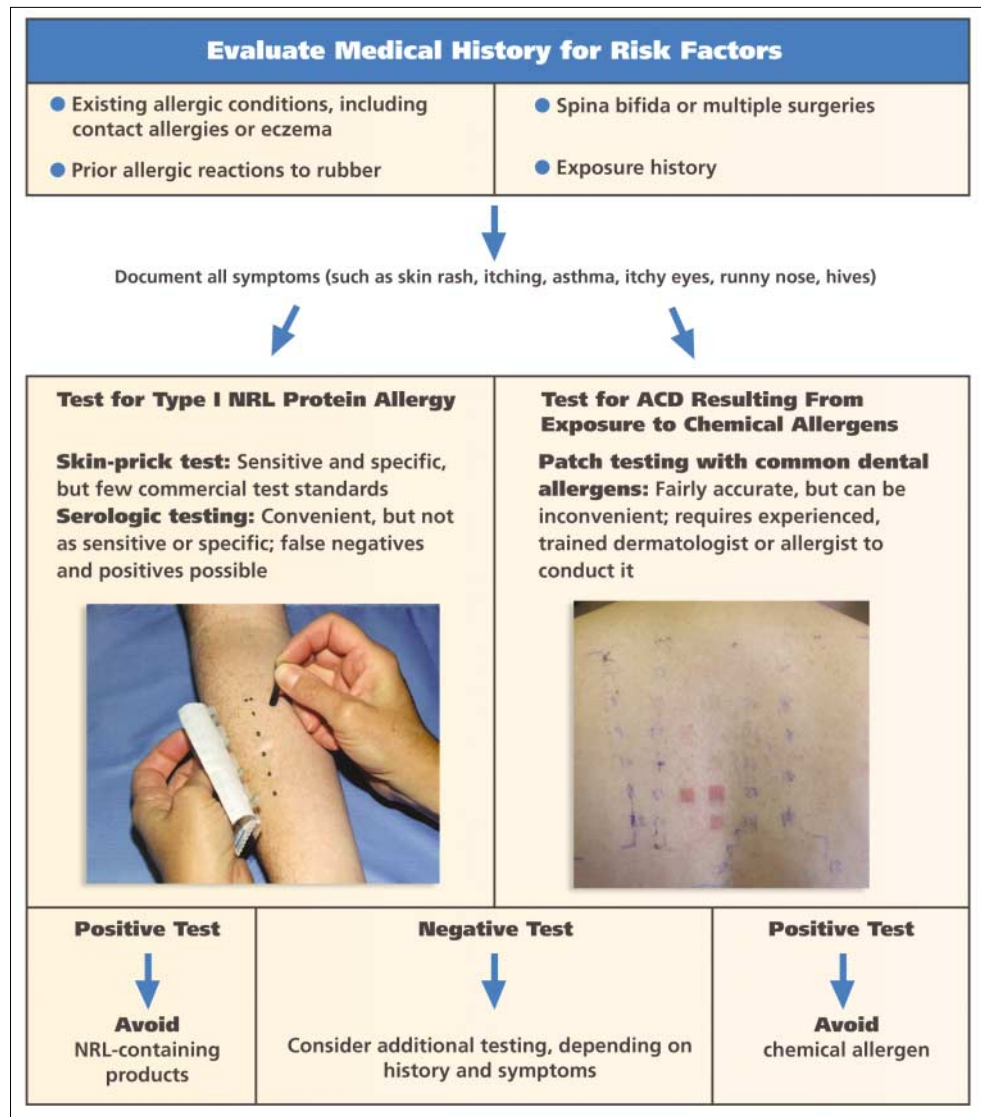


Figure 1. Diagnostic algorithm for occupational allergies in dentistry. NRL: Natural rubber latex. ACD: Allergic contact dermatitis.



Figure 2. Skin with red, edematous patches symptomatic of contact dermatitis resulting from exposure to dental contact allergens.

related ACD.⁵⁸ Finally, when patch test (for ACD) or SPT (for type I NRL protein allergy) results are negative, skin reactions may be diagnosed as ICD, if consistent with the dental care worker's symptoms and health history.

EDUCATION: THE ULTIMATE KEY

Healthy, intact skin is the quintessential barrier to pathogen transmission. Therefore, dental professionals should receive instruction about basic skin biology and proper hand hygiene, as well as guidance on the appropriate use of hand care products. The 2003 infection control guidelines for dental care workers published by the Centers for Disease Control and Prevention⁶⁰ emphasizes these issues. Opportunities for training exist at dental schools, in continuing education courses and through online programs.

Dental professionals also must be taught to avoid potential allergens and manage existing occupational allergies. Research has shown that patients with allergies who do not receive sufficient instruction have persistent problems with

their skin.⁶¹ In one study, health care workers without additional training regarding allergies continued to choose products to which they were allergic.⁶² In contrast, workers who are educated about their allergy and received product content information were more likely to avoid products that made their symptoms recur.⁶³

Dental professionals must become more knowledgeable about the chemicals they handle. Many chemicals are shipped to customers with MSDSs per U.S. Department of Transportation requirements. If these are not available, manufacturers and distributors often supply technical information (white papers) and ingredient listings that identify potential allergens and hazardous substances. Manufacturers or distributors also can verify the presence of specific allergens and provide content documentation for workers with allergies.

Internet-accessible chemical and allergen databases also can be found (Box). The National Institute of Occupational Safety and Health (NIOSH) provides basic safety and exposure information. Glove manufacturers often provide basic chemical resistance information. Lists of potential allergens and their sources also can be found online through diagnostic test manufacturers and dermatologic associations. The American Contact Dermatitis Society provides member physicians a database of allergens, sources and alternatives so that dermatologists and allergists can educate their patients successfully about avoidance.⁶⁴ In addition, the Spina Bifida Association of America maintains a current extensive list of consumer and medical products that contain NRL and latex-free alternatives.

MANAGEMENT

In dental care workers with occupation-based allergies, management of the allergy is based on avoidance of the allergen. This is accomplished effectively through judicious use of alternative products and by isolating workers from exposure to the allergen. This paradigm generally applies to both type I NRL protein allergy and ACD resulting from exposure to chemical allergens, as well as to substances that may be skin irritants. Essentially, dental care workers must mitigate the opportunity for their immune systems to respond.

As recommended by the American Dental Association and NIOSH, latex allergy management protocols should be developed for the dental office

that apply to both patients and workers.^{65,66} Critical elements include the taking of health histories to help assess risk, procuring alternative materials (currently required by the Bloodborne Pathogen Standards of the Occupational Safety and Health Administration⁶⁷) and emergency preparedness for any adverse reactions in patients or workers.⁶⁸ Adoption of allergy management protocols in the dental office can facilitate awareness, minimize unnecessary exposures and encourage early treatment.

Controlling type I NRL protein allergy. Dental professionals with a type I NRL protein allergy should avoid direct contact with natural rubber. Environments with aerosolized NRL protein from powdered NRL gloves or other products also should be avoided.^{3,6,40} Workers with allergies can safely use gloves and thin-film products made of synthetic rubbers (such as nitrile, vinyl and neoprene), which do not contain NRL proteins (Table 3). Synthetics also are used in other dental products such as polyurethane dental dams, silicone rubber bite blocks and tubing, and plastic prophylaxis cups. Through the use of barrier films, workers also can insulate themselves from direct contact with natural rubber components on dental equipment. Product manufacturers, health care organizations and professional societies can help identify products that contain NRL.

Despite some marketing claims, NRL gloves and other products are not dependably safe for use by dental workers with a type I NRL protein allergy. Although studies indicate that the NRL protein content in medical gloves has diminished in recent years, NRL allergen levels still can be sufficiently high to elicit symptoms in allergic workers.^{9,16}

Cornstarch-powdered NRL gloves with high protein content are considered a primary source of NRL allergens in the dental office.^{6,39} The NRL protein-laden powder can contaminate multiple areas of the dental environment. Therefore, for dental professionals who have allergies, offices should be cleaned thoroughly to remove repositories of NRL-contaminated powder and dust.

BOX

INTERNET RESOURCES REGARDING SKIN ALLERGIES.

- **Basic safety and exposure information:** The National Institute of Occupational Safety and Health (Washington), "www.cdc.gov/niosh/topics/chemical-safety"
- **Basic glove chemical resistance information:** Best Manufacturing Company (Menlo, Ga.), "www.chemrest.com"; and Ansell Healthcare (Red Bank, N.J.), "www.ansellhealthcare.com/america/usa/barrier/page8.htm"
- **Lists of potential allergens and their sources:** manufacturers of diagnostic tests such as T.R.U.E. Test (Mekos Laboratories, Hillerød, Denmark), "www.truetest.com/physician/comp.htm"; and dermatologic associations such as the American Academy of Dermatology (Schaumburg, Ill.), "www.aad.org/public"
- **Database of allergens, sources and alternatives (access restricted to member physicians):** the American Contact Dermatitis Society (Chicago), "www.contactderm.org"
- **A list of consumer and medical products that contain natural rubber latex and latex-free alternatives:** the Spina Bifida Association of America (Washington), "www.sbaa.org"

Ideally, nonallergic office staff members should use powder-free or lightly powdered NRL gloves with an NRL allergen content of less than 10 micrograms per decimeter squared surface area.⁸ If NRL allergen content information is not available or current, choose powder-free NRL gloves with an NRL protein content of less than 50 µg per gram weight for use by nonallergic staff members. Alternatively, co-workers without allergies can wear gloves made of a synthetic rubber or thermoplastic polymer, and these can be powdered or powder-free.^{6,8} The overall goal is to reduce the level of airborne NRL allergens to below 10 nanograms per cubic meter by reducing both NRL protein and powder levels.^{6,8} Implementing this strategy in health care environments has been shown to be effective in reducing symptoms in people with allergies and lowering the incidence of new allergies.^{8,9,39}

Controlling ACD reactions to dental contact allergens. Reducing exposure to rubber processing chemicals such as thiurams or carbamates can be challenging, because they are included in a wide range of rubber products (Table 3). They also may be found in products not made of rubber, such as garden fungicides and over-the-counter personal care products. Owing to their structural similarity, thiurams and carbamates can interconvert and cross-react.⁶⁹ Therefore, dental care workers with ACD resulting from exposure to thiurams or carbamates should avoid products that contain either of these chemicals. Workers with allergies should use gloves

TABLE 3

| RUBBER POLYMERS COMMONLY FOUND IN GLOVES AND DENTAL PRODUCTS. | | |
|--|-------------------------|-----------------------------------|
| POLYMER | CONTAINS NRL* PROTEINS? | CONTAINS COMMON RUBBER CHEMICALS? |
| Butadiene Methyl Methacrylate | No | Yes |
| Butyl Rubber | No | Yes |
| NRL | Yes | Yes |
| Nitrile, Chloroprene (Neoprene) and Blends Thereof | No | Yes |
| NRL Blends With Nitrile or Chloroprene | Yes | Yes |
| Polybutadiene | No | Yes |
| Polyvinyl Chloride (PVC, Vinyl), Polyurethane (Such as Intacta [†]) and Blends Thereof | No | No |
| Silicone Rubber | No | No |
| Styrene-Based Copolymers (Elastylon [‡]) [§] | No | No |
| Synthetic Polyisoprene | No | Yes |

* NRL: Natural rubber latex.
 † Manufactured by Dow Chemical, Midland, Mich.
 ‡ Manufactured by ECI Medical Technologies, Bridgewater, Nova Scotia, Canada.
 § Deteriorates when used with some methacrylates in bonding agents and cements.

and other products (such as dental dams) made of polyvinyl chloride (PVC or vinyl), polyurethane (polyisocyanates) or styrene-based copolymers. Although these materials do not contain vulcanization accelerators or antidegradants, they may contain allergenic plasticizers, stabilizers, ultraviolet absorbers, fungicides, biocides and colorants that can be problematic for some people.

To mitigate skin exposure to the methacrylates in bonding agents and other products (Table 2), dental professionals must learn to use a no-touch technique. Medical-grade gloves are not sufficient protection, and utility gloves with appropriate chemical resistance are too cumbersome for dental applications. Most methacrylates rapidly permeate and can even destroy natural and synthetic rubber polymers.⁷⁰ Recent research suggests that urethane dimethacrylates may not permeate some medical glove polymers.⁷¹ If confirmed, bonding agents with this chemical might be safely handled with polychloroprene gloves (Neoprene [DuPont Dow Elastomers, Wilmington, Del.]). However, further research is needed before any recommendations can be made.

Switching to a product with a different methacrylate generally is not an effective

strategy. Many methacrylates cross-react, so that sensitization to one confers an allergy to others.⁴⁴ When working with methacrylates, sufficient ventilation should be provided to prevent asthmalike symptoms and airway irritation already documented in the literature.^{21,45} It also should be noted that repeated exposure to uncured methacrylates can induce peripheral nerve damage, underscoring the need to avoid any direct contact with these chemicals.⁷²

Dental worker exposure to glutaraldehyde can be reduced by changing

to instrument disinfection-sterilization systems using hydrogen peroxide, peracetic acid or heat.⁶⁰ Alternatively, dental workers can use thick, heavy-duty, chemically resistant utility gloves to handle glutaraldehyde-soaked instruments and solutions. Medical-grade gloves are not dependably resistant to glutaraldehyde solutions because of variations in glove materials, thickness and formulations. Finally, because glutaraldehyde vapor also can stimulate respiratory symptoms in allergic workers, containment and adequate ventilation is strongly advised.^{20,47}

Controlling ICD in reaction to dental irritants. As with ACD, management is based on reducing or avoiding exposure to chemicals that can damage the worker's skin. This may involve substituting an equally effective but less harsh chemical or finding an alternative process. Reevaluating office instrument cleaning and disinfection techniques, housekeeping procedures, personal protective apparel and chemical preparation and handling processes can eliminate exposure to many potential irritants.²⁵

All dental professionals should revisit basic hand hygiene, including hand washing and the use of lotions and creams. Selecting mild hand

cleansers with lower alkalinity and few additives is helpful in minimizing ICD symptoms.⁶⁰ Emollients and moisturizers in creams and lotions can be useful in restoring the skin's barrier function and improving moisture content.⁷³ However, these creams and lotions should not be used under medical gloves. Many contain oil-based compounds that adversely affect glove materials, especially NRL.⁶⁰

SUMMARY

Dental and medical workers frequently report symptoms of occupational dermatoses. However, most are not caused by the widely publicized latex allergy. On the basis of current study data, it is more likely that dental professionals experience ACD resulting from exposure to one or more of the allergens in the dental office, such as methacrylates, glutaraldehyde and rubber processing chemicals.^{19-21,23} There also may be an equal or greater number of people with ICD reactions to these chemicals.^{4,17,18}

Chronic occupational skin disease has a relatively poor prognosis. Given the implications, it is imperative that dental care workers be educated about proper hand hygiene through improved training programs at dental schools and professional education venues. Any person with dermatologic problems should be evaluated by an experienced physician. In addition, management policies should be established that encourage dental care workers to be proactive, avoiding potential allergen and chemical exposure, and recognizing problems early. Healthy skin is a vital barrier against abrasion, chemical irritants and infectious agents and should not be undervalued. ■

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