

Contact Dermatitis in the Bowling Pro Shop

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A 29-year-old bowling pro shop operator presented with recurrent disseminated erythematous and edematous patches and plaques. Patch-testing with the North American Contact Dermatitis Group (NACDG) standard series yielded ++ and + reactions to epoxy resin at 2 and 7 days, respectively. We could find no other report of epoxy resin contact allergy in a bowling pro shop operator.

EPOXY RESINS (ERs) are ubiquitous chemicals, 75 to 90% of which are based on epichlorohydrin and bisphenol A (diglycidyl ether of bisphenol A [DGEBA]).¹ Most health hazards from ER systems occur in the occupational setting during the production of ERs or during the manipulation of the finished epoxy product²; bowling pro shop operators are affected by the latter category of exposure. These qualified and expert technicians offer many different services, such as fitting and drilling ball holes, hole plugging, ball maintenance (resurfacing, shining, polishing, and cleaning), and installation of finger inserts.³

Case Report

A 29-year-old male pro shop operator presented with an 8-month history of recurrent dermatitis consisting of disseminated scaly erythematous and edematous patches and plaques involving most of his face, neck, trunk, and extremities and sparing his lower back and feet. He had been working in a bowling alley for the past 14 years as a repairman, cleaner, and polisher of bowling balls. He had no personal history of atopic dermatitis, allergic rhinitis, or asthma.

The patient was patch-tested with the North American Contact Dermatitis Group (NACDG) standard series, acrylic series, plastics and glues series (Chemotechnique Diagnostics, Vellinge, Sweden), and the patient's non-epoxy-containing work polishes, finishes, and gloves, according to methods described by the NACDG, with Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) on Scanpor tape (Norgesplaster Aksjeselskap, Vennesla,

Norway). Only ER 1% in petrolatum (Epicote 827, Hexion Specialty Chemicals B. V. Rotterdam, The Netherlands), based on DGEBA (Bo Niklasson, Chemotechnique Diagnostics, personal communication, November 27, 2006), gave positive ++ and + reactions at 2 and 7 days, respectively. Of note, the patient had been tested 3 months earlier at another clinic with the Thin-Layer Rapid Use Epicutaneous (T.R.U.E) Test, which showed positive patch-test reactions to nickel, caine mix, and lanolin; the reaction to ER was negative, which may be a result of the higher false-negative reaction rate reported with the T.R.U.E Test (Mekos Laboratories A/S, Hillerød, Denmark) as compared with tests using petrolatum-based allergens in Finn Chambers.^{4,5} He was not tested with his workplace ER.

After further review, we determined that our patient's primary exposure to ER was from a two-part bowling ball plugging kit (see Table 1); according to the Material Safety Data Sheets, the kit contained DGEBA. ER was not listed as an ingredient in his polishes, finishes, and lane oil. Follow-up information obtained by phone 15 months after his last visit revealed the persistence of his dermatitis, mainly on exposed areas of the face, neck, and arms. He continues to work as a bowling pro shop operator with the same exposures, and his rash improves when he is on vacation. He has been wearing personal protective equipment (protective eyewear, purple medical gloves, and a face mask). He reports that his work area is not well ventilated, and he is considering changing his job.

Discussion

Potential ER Exposures

Bowling Pro Shops

The different pro shop services offered in bowling centers include fitting and drilling ball holes, hole plugging, ball maintenance (resurfacing, shining, polishing, and clean-

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Table 1. Work Exposure to Epoxy Resin: Pro-Plug Ball Plug (Brunswick Corp.)

Pro-Plug Ball Plug–Resin Compound (part A)

- Proprietary DGEBA

Pro-Plug Ball Plug–Epoxy Hardener (part B)

- Proprietary curing agent
- Proprietary polymer
- Proprietary additives
- Amines

ing), and installation of finger inserts.³ Bowling pro shop operators are exposed to ERs and other chemicals through contact with ball plugging compounds, coatings, finishes, and adhesives.

To obtain information about ER exposure in bowling pro shop operators, four different pro shop centers in Cleveland were interviewed by phone, and an on-site visit was made to one. A two-part epoxy resin-hardener compound at a concentration of 3:1 (resin to hardener) was the only material used by these pro shop operators during the plugging of bowling ball holes. None of the operators wore protective gloves or masks during the performance of their tasks, but the operators referred to the workplaces as “well ventilated.” Handling epoxy materials that are incompletely cured or in a liquid state exposes the user to potential sensitization and the subsequent development of allergic contact dermatitis.¹ At the pro shop center that we visited, the operator was working without gloves or other protective equipment while pouring and mixing the two-part epoxy ball plug. He removed the excess of this material in its liquid state from the ball with his bare finger (Figs 1 to 7).

Other sources, including bowling ball manufacturers (Ebonite International [Hopkinsville, KY]; Columbia 300, Inc., [now owned by Ebonite International]; Brunswick Corp. [Lake Forest, IL]; and Storm Products, Inc. [Brigham City, Utah]), the manufacturer of Tech-Line ball plugging products (Spring Lake, Michigan), and the International Bowling Pro Shop and Instructors Association (IBPSIA, Arlington, TX) were also contacted for further information on bowling ball materials and allergen alternatives. None provided additional information, and the IBPSIA stated that “an epoxy allergy case has never been reported in 40 years” (IBPSIA ex-director and pro shop operator Mark Gelfand, personal communication, October 2006).

Bowling Balls

Historically, makers of bowling balls have used various materials, from stone and wood to the reactive and particle

**Figure 1.** Example of a bowling ball, showing the shell or coverstock. (Reproduced with permission from Track International Inc.)

resins (Table 2).^{6,7} In August 2005, Columbia 300, Inc., launched the EPX-T1 ball, which had a coverstock or shell made of ER from which plasticizers and additives bled through to the surface. This formulation created a rough surface for increased friction, allowed absorption of lane

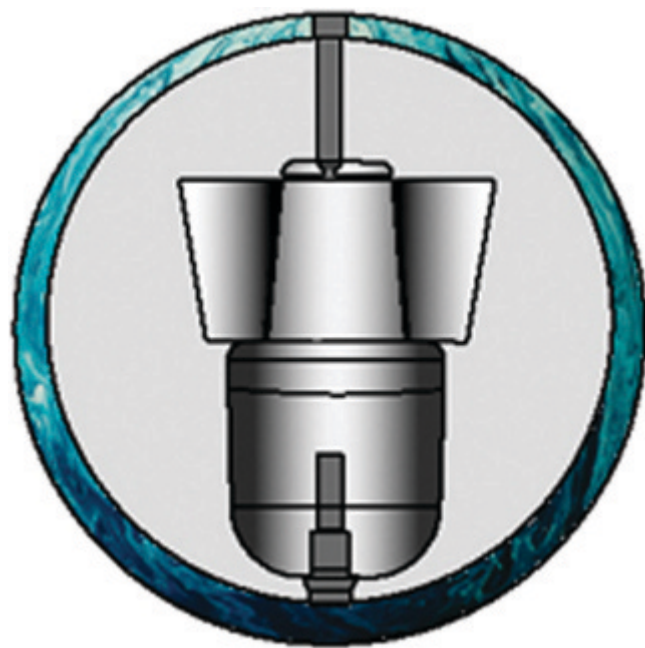
**Figure 2.** Diagram of a bowling ball, showing the core. (Reproduced with permission from Track International Inc.)



Figure 3. Bowling ball plugging, step 1: filling a clear plastic cup with a two-part epoxy resin/hardener. Note the lack of use of protective gloves.

oil onto the ball,⁸ and complicated the cleaning of the ball. In addition, the ball's increased fragility (cracking) led to its removal from the market in early 2006. During this period, no cases of dermatitis were reported to the manufacturers of this "bleeding ball" (Chad Murphy, Columbia 300, Inc., personal communication, July 3, 2007).



Figure 4. Bowling ball plugging, step 2: mixing the epoxy compound by hand.



Figure 5. Bowling ball plugging, step 3: pouring the epoxy into the bowling ball hole.



Figure 6. Bowling ball plugging, step 4: wiping away excess epoxy resin with a bare finger.



Figure 7. Bowling ball plugging, step 5: the hole of the ball is plugged and ready to cure for 12 hours.

Bowling Game Players

Pro shop operators are not the only ones who face the hazards of being exposed to bowling products. There have been three previous reports of dermatitis in six players of the outdoor game of lawn bowling^{9–11}; only one of them had a positive patch-test reaction to ER.¹¹ In this case, Lyon and colleagues demonstrated the presence of ER in the player's bowl polish by gel permeation chromatography followed by high-performance liquid chromatography; the polish was also rubbed into the player's hands prior to a game, to enhance the grip on the bowl.¹¹

Epoxy Resin Alternatives and Precautions

The proposed allergen substitution for our patient was a urethane-based plugging compound produced by Wizard (Ultimate Bowling Products, Inc., Louisville, KY). Unfortunately, this product has two disadvantages: (1) it

is apparently the only product available and is not well known by suppliers and pro shop operators, and (2) it has a curing time of only 1 hour (as opposed to the 12-hour curing time of a regular two-part epoxy ball plugging material), which causes the compound to shrink, subsequently leaving an incompletely filled ball hole.

A “no-touch” technique is highly recommended for bowling pro shop operators working with ER products. This can be achieved by the use of personal protective equipment such as gloves; the best protection is offered by the multilayered polyethylene–ethyl vinyl alcohol Silver Shield/4H gloves (North Safety Products, Cranston, Rhode Island). Nitrile, heavy-duty vinyl, and polyvinyl chloride gloves are also useful. It is also recommended that a protective mask be worn and that a dust respirator and protective glasses be used if a ball is being drilled. Additionally, the work area should have adequate local exhaust ventilation and regular cleaning and maintenance of all contaminated equipment. The possibility of delegating the job to others should be also considered, but appropriate precautions to avoid sensitization should always be taken. Workers handling ERs should be informed of the risk of skin sensitization and advised to refrain from skin contact.¹

Conclusion

A patient with a clinical history of exposure to epoxy resins (ERs) and who presents with contact dermatitis should be patch-tested with ER 1% in petrolatum, included in most standard series. If the results are negative for ER, then test with additional commercially available epoxy patch-test chemicals and the patient's own epoxy products. Other types of ER systems can be irritants, and patch-test

Table 2. Bowling Ball Materials

<i>Material</i>	<i>Year Developed</i>	<i>Comments</i>
Stone	5200 BC	Used by ancient Egyptians
Wood (especially oak)	Before 1900s	First bowling balls used in the United States
Hard rubber	1906	The only type of balls available (Brunswick Corp.)
Plastic (polyester)	1960s	—
Urethane (polyurethane)	1980s	—
“Reactive” resin urethane	Early 1990s	Resin particles added to the urethane ball to enhance performance
“Proactive” particle resin	1998	Small particles of silica, ceramic, mica, or rubber are mixed within the reactive resin.
EPX-T1 (Columbia 300, Inc.)	2005	Epoxy resin shell; plasticizers; was a “bleeder”; off market since 2006

Adapted from Bowling⁶; The history of bowling materials.⁷

concentrations of 0.25 to 1% are generally recommended.¹ If contact allergy to hardeners or reactive diluents is suspected, it may be necessary to obtain information and samples from the manufacturers and to test the components of the ER systems separately at concentrations of 0.1 to 1% in petrolatum, acetone, or ethanol.¹

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