

Contact Dermatitis from a Prosthesis

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Patients wearing a prosthesis face a wide variety of medical problems. Skin complications have long been recognized, but their prevalence is still unknown. The most frequently reported disorders are allergic contact dermatitis (ACD), acroangiodermatitis, epidermoid cysts, epidermal hyperplasia, follicular hyperkeratosis, verrucous hyperplasia, bullous diseases, hyperhidrosis, infections, malignancies, and ulcerations. Contact dermatitis represents one-third of the dermatoses in amputees wearing prostheses. All patients who are suspected of having ACD should be patch tested with standard allergen series as well as materials from the patient's own prosthesis, topical medicaments, moisturizers, and cosmetics.

We report a patient with an ACD to mixed dialkyl thiourea present in the rubber parts of his below-the-knee prosthesis. Thiourea derivatives are used as accelerators in the manufacture of chloroprene rubber and as fixatives in photography and photocopy paper. Allergy to thiourea is relatively uncommon; different studies have shown a prevalence of 0.7% up to 2.4% in patch-tested patients. Thiourea derivatives are often the allergic sources in ACD involving high-grade rubber products made of neoprene such as diving suits, protective goggles, knee braces, and continuous positive airway pressure masks. They are also present in the rubber material of prostheses, as in the case of our patient.

PATIENTS WHO WEAR A PROSTHESIS face a wide variety of medical problems. Skin complications have long been recognized, but their prevalence is still unknown. Even though the devices have improved greatly in recent years, the skin under the prosthesis is subject to many abuses.¹ The most frequently reported disorders are allergic contact dermatitis, acroangiodermatitis, epidermoid cysts, epidermal hyperplasia, follicular hyperkeratosis, verrucous hyperplasia, bullous diseases, hyperhidrosis, infections, malignancies, and ulcerations.^{2,3}

Contact dermatitis represents one-third of the dermatoses in amputees who wear a prosthesis.^{2,4} This may be due to materials (in the prosthesis itself or in the straps or attachments) that produce an allergic reaction in a previously sensitized patient. In such cases, patch testing is an excellent diagnostic tool that should be used in all patients for whom there is suspicion of contact dermatitis.

We report on a patient with an allergic contact dermatitis to mixed dialkyl thioureas in the rubber parts of a below-the-knee prosthesis.

Case Report

A 62-year-old African American male with a past medical history of diabetes mellitus and a traumatic amputation and who was wearing a below-the-knee prosthesis

presented with a 3-month history of a severely pruritic plaque. The problem began on the right limb and then spread to the arms and the face. On the physical examination, the patient presented with patchy hyperpigmented lichenified plaques on the dorsal and ventral aspects of the right thigh (Fig 1). There were smaller scaly hyperpigmented plaques on both arms. He was treated with topical clobetasol propionate 0.05% ointment on the affected areas, oral antihistamines, and moisturizers, with partial resolution of the eruption.

The patient subsequently returned for patch testing with the North American standard series and with materials from his own prosthesis. Patch testing was conducted with Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) under cover-roll stretch. At the 48-hour and 96-hour readings, the patient was found to have ++ reactions



Figure 1. Patchy hyperpigmented lichenified plaques on the dorsal and ventral aspects of the patient's right thigh.

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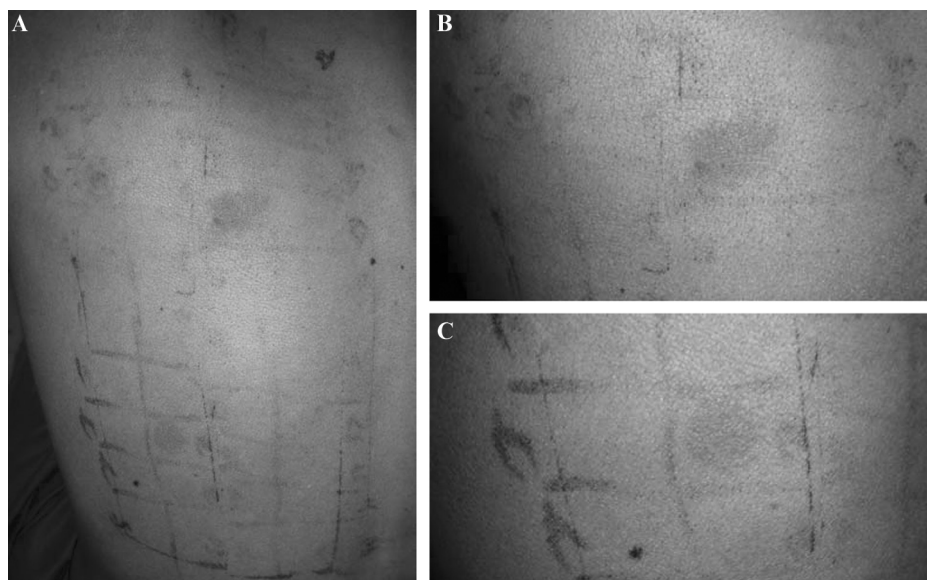


Figure 2. A, Patch-test results at 96-hour reading. B, Reaction to mixed dialkyl thioureas 1% (++). C, Reaction to potassium dichromate 0.25% (++)

to potassium dichromate 0.25% and mixed dialkyl thioureas 1% (Fig 2).

After patch testing was performed, an intramuscular injection of triamcinolone (40 mg) was administered. The patient stopped using the prosthesis, with resolution of the symptoms after 3 weeks. The prosthetics department agreed to give the patient an alternate prosthesis without thioureas.

Discussion

The prevalence of limb loss in the United States is 4.9 per 1,000 persons. The most common causes are vascular disease and trauma. Malignancy of bone and joint and congenital limb deficiency are less frequent causes.⁵ Using a prosthesis allows the patients to restart their normal lives, go back to work, and reassume their normal activities.

The use of a prosthesis requires good skin integrity on the residual limb. Despite advances in the design and construction of artificial limbs, the skin of an amputated limb shaft is not adapted to the heat, humidity, friction, and pressure resulting from the daily use of the prosthesis. The stump skin also supports a larger population of bacteria than the normal limb skin. Prosthetic materials and products such as cleansers used in their maintenance may have irritant or allergenic effects. Consequently, some skin problems after limb amputation are inevitable. Furthermore, occlusion and humidity might be expected to increase the likelihood of contact sensitivities to the constituents of moisturizing creams, medicaments, and the prosthesis itself.^{1,2}

The prevalence and incidence of skin problems on the amputated limb is unknown. In a literature review of 76 cases of amputation, Meulenbelt and colleagues found that the most frequently reported disorders were acroangiadermatitis, allergic contact dermatitis, bullous diseases, epidermal hyper-

plasia, hyperhidrosis, infections, malignancies, and ulcerations.³ In a study of 210 amputees, Lyon and colleagues² reported that 34% of their patients experienced a skin problem. Among those patients, contact dermatitis represented more than one-third of the cases. Other disorders included epidermoid cysts, follicular hyperkeratoses, verrucous hyperplasias, ulcerations, and infections.

Owing to all of the predisposing factors mentioned above, contact dermatitis is a very frequent entity among amputees who wear a prosthesis. It usually presents as an erythematous weeping pruritic eruption. Repeated contact of the prosthesis with the skin results in a chronic dermatitis with subsequent lichenification, hyperpigmentation, and itching. The reaction may be localized or more diffuse.²

Contact dermatitis may be due to materials (in the prosthesis itself or in the straps or attachments) that produce an allergic reaction in a previously sensitized patient. The cases of prosthesis-induced allergic contact dermatitis (ACD) reported in the literature have shown different allergens. When the main component of lower-limb prostheses changed from wood to plastics and rubbers after World War II, the types of allergens also changed.³ There are reports of different allergens, such as para-tertiary butyl-phenol formaldehyde;^{2,3,6} para-phenylenediamine;^{2,3} epoxy resins;^{2,3} para-tertiary butyl catechol;² fragrances present in moisturizers, talc, and creams used by the patients;² thioureas;^{2,7-9} and others.^{2,3,6}

All patients should be patch-tested with the standard allergen series as well as with materials from the patient's own prosthesis, topical medicaments, moisturizers, and cosmetics. Subsequent patch testing with the extended series of plastic additives and adhesives would be indicated for those patients whose initial patch-testing results are negative.²



Figure 3. Prosthesis used by the patient. The rubber material of the prosthesis is shown on the right.

In the case of our patient, the patch-test reactions to potassium dichromate and mixed dialkyl thioureas were positive. Potassium dichromate is found in construction materials and is also a tanning agent for leather products.⁶ Thiourea derivatives are used as accelerators in the manufacture of neoprene (chloroprene rubber) and act as antioxidants that prevent neoprene from drying out.⁷ They are also used as fixatives in photography and in photocopy paper.⁹ Thiourea allergy is relatively uncommon; different studies have shown a prevalence of 0.7 to 2.4% in dermatitis patients undergoing patch testing.^{8,9} They are often the allergic sources of ACD involved with high-grade rubber products made of neoprene, such as diving suits, protective goggles, knee braces, keyboard wrist supports, and continuous positive airway pressure masks.^{8,10–12} They are also present in the rubber material of prostheses, as in our patient's case (Fig 3).

The treatment is primarily symptomatic, with corticosteroid creams or systemic steroids or both, as well as antihistamines.¹³ The definitive treatment is still the removal of the offending sensitizing agent. In this situation, help from the prosthesis manufacturer and the prosthetics department is invaluable.

Conclusions

Skin problems in patients who use prostheses are very common. Contact dermatitis represents more than one-third of these cases.^{2,4} The dermatitis may be due to materials (in the prosthesis itself or in the straps or attachments) that produce an allergic reaction in a previously sensitized patient.

In the case that we report, the patch-test results were positive for potassium dichromate and mixed dialkyl thioureas. Potassium dichromate is found in construction

materials. The patient indicated that he had worked in construction when he was young, so the sensitization may have occurred prior to the use of the prosthesis. We believe that potassium dichromate sensitization is not relevant to his current dermatosis.

Mixed dialkyl thioureas are present in high-grade rubber products made of neoprene, such as the rubber component of the prosthesis. The patient stopped using the prosthesis, with resolution of the symptoms after 3 weeks. This fact and the clinical correlation support the relevance of thioureas as sensitizers in this case.

A patient wearing a prosthesis who presents with a dermatosis suggestive of contact dermatitis should be patch-tested with the standard allergen series as well as with materials from the patient's own prosthesis, topical medications, moisturizers, and cosmetics. Subsequent patch testing with the extended series of plastic additives and adhesives would be indicated for those patients whose initial patch-test results are negative.

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