

Common skin pathology in LE prosthesis users

The nature of state-of-the-art skin-prosthesis interface puts amputees who use prostheses at increased risk for these common dermatologic conditions.

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In the United States, 7% of all outpatient ambulatory visits are for dermatologic complaints.¹ Lower extremity (LE) prosthesis users experience a higher incidence of such problems because of the skin-prosthesis interface. Plastic, silicone, or some other inorganic material is placed in direct, constant contact with the skin, predisposing the residual limb (RL) to a myriad of cutaneous pathology.

In addition to compromised vascular and lymphatic circulation, comorbidities such as diabetes and peripheral vascular disease (PVD) are common among LE prosthesis users. Diabetes, for example, is approximately 9 times more prevalent in LE amputees than nonamputees.² Sensory deficit, pain, healing, RL volume, prosthetic environment, and fit affect cutaneous hygiene for the LE prosthesis user. For this project, 261 patient encounters that occurred during a 12-week period were reviewed. Of these, 30 patient visits involved some type of skin-related problem in a patient who used a LE prosthesis.

In our patients, the six most common diagnoses were pressure sores, infection, irritant contact dermatitis, negative pressure hyperemia, intertrigo, and xerosis. All the participants were LE amputees who functionally wore and used a prosthesis. History, diagnosis, management, timeframes, and clinical outcomes were followed.

PRESSURE SORES

Decubitus ulcers, or *bed sores*, the most common form of pressure sores, are typically seen on the heels and sacrum of supine or bed-bound patients. However, pressure sores can develop on any skin where mechanical pressure is applied focally over a bony prominence. In LE prosthesis use, an ill-fitting socket creates focal pressure coupled with shearing force applied to a nontraditional area, such as the tibial tubercle or at the amputation site; this initiates irritation and inflammation of the superficial layers of the skin (Stage I). Continuous weight-bearing further degrades the integrity of the skin. The skin may become compromised as the pressure sore erodes deeper into the epidermis or dermis (Stage II), then into the subcutaneous layers to the fascia (Stage III), and eventually to muscle or bone (Stage IV). Sensory def-



FIGURE 1. Stage II pressure sores on the residual limb of a patient with a transtibial amputation

icits, such as those seen in patients with diabetes, compound this problem. When pain sensation is absent, ambulation continues and the pressure sore is further aggravated.

CASE 1 A 44-year-old male with a right transtibial amputation (TTA) presented to hospital complaining of difficulty donning his prosthesis and ambulating with it. He had sores on the RL. The patient's history is significant for smoking, diabetes, hyperlipidemia, and chronic venous insufficiency; he has no sensation in the RL. Physical examination revealed an antalgic gait and an insufficiently donned prosthesis; he was not wearing a prosthetic sock. Cutaneous examination revealed edema distal to the tibial tubercle of the RL and three erythematous ulcerated erosions that reached into the dermis. Sores superficial to the tibial tubercle, superficial to the distal anterior residual tibia, and superficial to the medial aspect of

the patella also were noted (see Figure 1, page 33). Acute volume increase prevented the prosthesis from being fully donned and prevented the bony prominences from aligning with the reliefs in the prosthetic interface. As a result, focal loading on the unintended surfaces caused pressure sores.

Treatment The goal was to decrease focal pressure and shearing forces. Resolution required volume management as well as pressure relief. Initially, the patient was instructed not to wear his prosthesis for 1 week to allow the ulcers to heal. Additional instructions included to elevate the RL when sitting and to begin wearing his shrinker in 4 days. At 1-week follow-up, the pressure sores had improved from Stage II to Stage I. The patient was then instructed to wear the prosthesis for not more than 4 hours each day and to inspect the skin every 2 hours. He also was instructed to continue to elevate the RL when sitting or lying down and to wear his shrinker as much as tolerated when not wearing the prosthesis. Following this plan, the patient had a complete resolution of his condition in 2 weeks.

INFECTION

The integumentary system has several defenses to prevent local bacterial invasion, such as the immunologic Langerhans' cells and lymphocytes, competing normal flora of microbes, and, finally, the dry, dead, impermeable cells of the stratum corneum. Trauma, excessive heat, and increased moisture can compromise these defenses. Common skin infections in amputees include fungal and bacterial etiologies. Most infections are restricted to local sites; systemic involvement is possible but rarely life threatening.

Fungal infections, usually caused by dermatophytes, are common. The stratum corneum is a food source for dermatophytes, which digest keratin; this process loosens the upper skin layer and accounts for the scaling that occurs. *Candida albicans* is a yeast routinely found on skin and mucous membranes. Candidiasis is an opportunistic infection that activates an inflammatory response, which typically appears as bright red patches.

Pathogenic bacteria also can cause skin infections. The most common is *Staphylococcus aureus*, which colonizes in the skin and elicits an immune response from chemotactic factors. Neutrophils and enzymes cause purulence and inflam-



FIGURE 2. Methicillin-resistant *Staphylococcus aureus* infection acquired through a scratch on the residual limb

mation. Less commonly, streptococci can invade damaged skin and release enzymes that elicit an inflammatory response.

CASE 2 A 40-year-old male with a right TTA reported being scratched by his recently acquired pet kitten. His history is significant for bipolar disorder, diabetes, diabetic retinopathy, and neuropathy. The patient stated that the animal scratched the RL near the distal insertion of the lateral hamstring, near the joint line (see Figure 2). Pain and swelling began within 1 day of being scratched, and wearing the prosthesis was intolerable within 30 hours. The site became exquisitely tender and bright red; the patient then felt “fever and chills,” which prompted him to go to the emergency department (ED) for evaluation.

Treatment The ED physician advised the patient to replace the silicone gel liners because the old ones could be contaminated. Empiric antibiotics were administered, and the patient was referred to his primary care provider (PCP) and prosthetist for follow-up. In the follow-up with his PCP, a culture revealed methicillin-resistant *S aureus*. The wound was debrided, and topical antibiotics were applied. The patient was counseled on contact precautions, and his antibiotic regimen was adjusted. Home health nursing staff continued his follow-up care, including minor debridement, cleaning, inspection, and daily dressing changes. New prosthetic soft

KEY POINTS

- In prosthesis users, plastic, silicone, or some other inorganic material is placed in direct, constant contact with the skin predisposing the residual limb to a myriad of cutaneous pathology.
- The six most common diagnoses made by the authors were pressure sores, infection, irritant contact dermatitis, negative pressure hyperemia, intertrigo, and xerosis.
- All health care providers with amputee patients who use prostheses should have a basic knowledge of the common dermatologic ailments associated with prosthesis use.
- Because most cases of skin pathology in amputees are medically complex, collaboration between disciplines is routinely necessary. Comorbidities related to diabetes, peripheral vascular disease, and other pathologies affecting cardiac and neurologic status can easily warrant consultation with other medical specialists.

COMPETENCIES

- Medical knowledge
- Interpersonal & communication skills
- Patient care
- Professionalism
- Practice-based learning and improvement
- Systems-based practice

goods, primarily new silicone gel liners that directly contacted the skin, were prescribed. The patient was advised not wear his prosthesis until the infection resolved and the skin healed, which could take 1 month or longer. He also was advised that his prosthesis socket may not fit; it would have to be re-evaluated, and possibly remade.

IRRITANT CONTACT DERMATITIS

Irritant contact dermatitis occurs when a physical agent is applied long enough or in a high enough concentration to cause cellular damage that disrupts normal skin integrity and function. Typically, the inflammatory response is limited to the site of contact, which may itch or burn. Dry skin, chronic scratching, and rubbing exacerbate the problem. Other predisposing factors include white skin, low humidity, occlusion, mechanical irritation, and having an atopic background (family history of atopic dermatitis, asthma, allergic rhinitis, etc). Management includes avoiding the offending agent and using physical barriers and/or barrier creams. Other forms of dermatitis that should be considered are allergic contact dermatitis and pressure urticaria.

Allergic contact dermatitis is a delayed hypersensitivity reaction to an allergen that develops a few days to several months after exposure. These lesions are acutely well defined and manifest with erythema, edema, and, occasionally, vesicles or an exudate. Treatment involves removing and avoiding the antigen and applying a topical corticosteroid, if mild; in more severe cases, systemic corticosteroids are administered. Pressure urticaria occurs within a few hours of constant pressure and dissipates similarly. Physically, it appears as erythematous swelling and may be itchy or painful.

CASE 3 A 74-year-old male with a left TTA presented for a routine follow-up approximately 2 weeks after a prosthesis socket replacement, which included new silicone gel liners. The patient complained of itching and irritation along the edge of the new gel liner after wearing the prosthesis for a full day. An erythematous patch of skin over the distal femur, posteromedially, and directly along the proximal edge of the gel liner was noted (see Figure 3). Although the silicone gel liner was in contact with much of the distal RL, only the proximal edge showed inflammation. Comorbidities included PVD, diabetes, and recent stroke.

Treatment The mid to distal aspect of the hamstring belly is commonly where silicone gel liners terminate in transtibial amputees. An OTC zinc oxide barrier cream was recommended for this patient. He was fitted with a nylon sheath to wear under the silicone liner. In addition, the liner was trimmed distal to the irritated site in a wave pattern, as opposed to a straight cut. The patient was advised to rotate the liner with each wearing to vary the contact points. A wave cut increases the length of material at the proximal/terminal end of the liner, thereby increasing the surface area and decreasing the proximal tension relative to a straight cut. Ten-day follow-up revealed marked improvement and near resolution. The patient was advised to follow-up again in 10 to 14 days, if necessary.

NEGATIVE PRESSURE HYPEREMIA

Patients commonly experience stump edema for several weeks after surgical amputation. In addition, when a suction suspended prosthesis is used, the RL may swell.³ Conservative volume management, typically achieved with a compressive shrinker sock, usually resolves the edema in a few weeks. The erythema gradually turns to a brown dyspigmentation and resolves without further incidence or treatment. However, if the volume of the RL changes, the fit of the suspension socket may be affected. Negative pressure continues even if the prosthesis is not in full contact with the skin. The suction then creates lymphatic and circulatory congestion at this void. The site is well demarcated and becomes edematous, erythematous, and very tender.

CASE 4 A 26-year-old female with a congenital right transverse tibial deficiency complete presented to the clinic in acute pain with an antalgic gait. The patient had a functional femur and associated hip musculature; however, she did not have an anatomic knee. She was fitted with a suction suspension prosthesis, similar to that for a knee disarticulation. Her prosthesis appeared to be functioning normally during ambulation. The patient was a smoker and was in otherwise good health. She reported recently gaining weight, despite making no changes in her diet or activity level. An acute sore on the distal medial aspect of the femur was noted (see Figure 4, page 36). On physical examination, the suspension of the suction socket satisfactorily held during a gentle, progressive pull. However, removing the socket revealed that the patient's RL was not making contact distally with the prosthesis. There was a tender erythematous patch on the distal medial femur.

Treatment The patient's RL was not making contact distally because the limb size had increased, possibly associated with the reported weight gain. Proximal limb volume and girth prevented complete donning. Lack of distal contact in this suction environment ultimately drew fluid distally when the prosthesis was in swing phase, creating negative pressure. The distal contact loss redistributed body-



FIGURE 3. Irritant contact dermatitis localized at the proximal edge of the liner

weight-related stance loads to other areas of the interface. Those areas were literally anywhere but distally, acutely overloading and irritating the more proximal tissues. Temporarily, a compliant foam pad was shaped to fit into the void at the distal aspect of the interface to reestablish full contact. The patient was advised to rest the RL and avoid wearing the prosthesis as much as possible for the next week to permit healing and allow any edema to begin dissipating. The patient was told that a new interface was indicated. At 1-week follow-up, healing was satisfactory, so an impression was made and measurements were taken for a new interface. The new interface was satisfactorily fitted 1 week later. Weekly follow-up visits continued for 3 weeks until cosmetic finishing was completed.

INTERTRIGO

When adjacent skin folds are in constant opposition, trapped sweat accumulates and removes the protective keratin from skin. A nonspecific dermatitis develops that may be pruritic, tender, or even painful. Such rashes are commonly seen in the intergluteal folds, submammary areas, inguinal folds, and axilla, but they also can be seen on the distal end of an amputee's RL. Continued friction may further break down the skin and can result in fissures, lichenification, or secondary infections.

CASE 5 A 40-year-old male with a left transfemoral amputation secondary to a motor vehicle accident presented to the clinic approximately 2 weeks after an ischial containment socket replacement. The patient complained of discomfort in the lateral distal femur. The discomfort was refractory to various prosthetic sock applications. Gait evaluation demonstrated left antalgia. Skin examination revealed an erythematous, macerated patch without scaling within an invaginated scar (see Figure 5).

Treatment In this situation, the skin is rubbing against adjacent skin while being compressed in the silicone liner; moisture is being trapped in the skin folds. The patient was instructed to apply an OTC topical zinc oxide cream, as directed on the label, for at least 1 week. He also was advised not to wear his shrinker at night, leaving the wound exposed to the air. Stump hygiene was reviewed. Additional instructions included to keep the opposing skin surfaces clean and dry, to check the skin frequently for further irritation or an increase in symptoms, and to call for a follow-up appointment if needed. The patient's wound showed satisfactory healing at the 1-week follow-up. The patient was told to call for further follow-up visits as needed.

XEROSIS

Xerosis is characterized by dry, scaly, rough skin (see Figure 6); it is extremely common and occasionally itchy. The condition afflicts at least 75% of people older than 64 years;³ most often affects the extremities; and is worse during dry, winter months. Xerosis was the most common skin condition in our patients and rarely the chief complaint.

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FIGURE 4. Acute erythema and edema resulting from loss of distal contact in a suction-suspended prosthesis



FIGURE 5. A macerated, erythemic patch seen when the skin of an invaginated scar is spread



FIGURE 6. Dry, scaly skin typically seen in xerosis

Skin pathology Continued from page 36

Treatment The condition was managed by instructing affected patients to avoid routines that may further dry the skin, such as excessive washing with soap and taking prolonged tub baths. Use of OTC skin moisturizers, applied as instructed on the product label, was recommended. Another management strategy was use of a humidifier in commonly used areas such as bedrooms. Standard recommendations included following proper hygiene practices and not applying lotion on open lesions unless instructed. Patients were always reminded to discontinue using any product and seek medical advice if their symptoms failed to improve or worsened. None of our patients followed up exclusively for complications of xerosis.

CONCLUSION

More than 11% of the prosthetic encounters that occurred during this 12-week period involved some form of dermatologic problem, an increase of 63% compared to the skin problems Stern and colleagues reported in the general population.¹ Not surprisingly, prosthesis users will be burdened at some point with skin issues because of the nature of the interface between the skin and the prosthetic socket. This being the case, all health care providers with amputee patients who use prostheses should have a basic knowledge of the common dermatologic ailments associated with pros-

thesis use. In most of our cases, conservative treatment produced successful outcomes.

Because most cases of skin pathology in amputees are medically complex, collaboration between disciplines is routinely necessary. Comorbidities related to diabetes, PVD, and other pathologies affecting cardiac and neurologic status can easily warrant consultation with other medical specialists. The most obvious collaboration here was between dermatologic clinicians and prosthesis specialists. **JAAPA**

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