



Technical Brief

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Verrucose Hyperplasia: A Problem from Open-end Prosthetic Sockets

By Yeongchi Wu, M.D.

Human skin serves as a boundary between the body and its surrounding environment. It protects the internal organs and is the first barrier against infectious organisms. For the amputee, skin of the residual limb has another important function in bearing the mechanical stress from wearing the prosthetic device.

The skin consists of two distinct layers, the “epidermis” and the “dermis” (*Figure 1*). Under these two layers is another layer of subcutaneous tissue. The dermis is thicker than the epidermis and provides strength and limited elasticity to the skin. It contains connective tissue, such as collagen fibers, that support glands, hair follicles, blood vessels, lymphatic vessels, and nerves. The epidermis is a nonvascular tissue. There are four sub-layers in the epidermis. Its deeper cells are nourished from extracellular fluid supplied from the vascular dermis underneath. In the inner most layer of the epidermis is basal cell, which grows into outer epidermal cells. The outer layer of epidermis are dead cells, which are flat, plate-like envelopes filled with keratin and held together by a cementing material in thickness from 15 to 25 layers. It makes the skin tough and elastic.

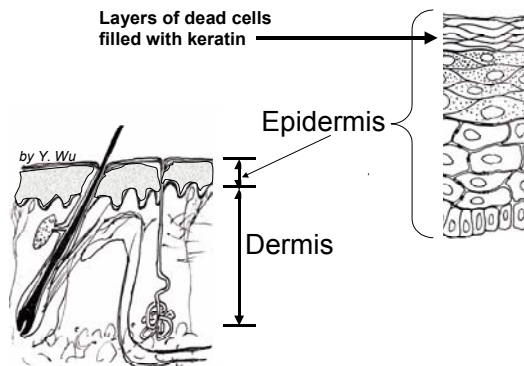


Figure 1, Structure of human skin

Under normal condition, oxygen-rich tissue fluid from the blood vessels to the capillaries circulates between the tissue cells, provides them with vital oxygen and nutrients, and is then returned to venous capillaries and lymphatic vessels. Amputation

surgery disrupts this normal circulation causing accumulation of tissue fluid (edema) in the site of amputation. Post-operative edema can be prevented by proper application of gradient compression with more pressure proximally than distally. This reduces fluid coming through arterial capillaries into the tissue where drainage is impaired.

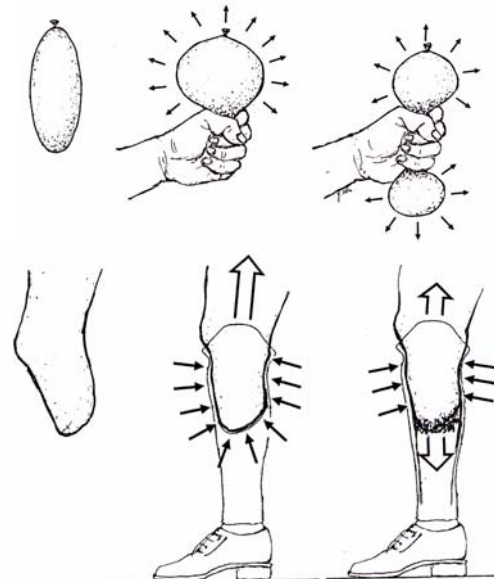


Figure 2, Holding a balloon at its end will push the air inside upward. Squeezing the balloon at the middle will push the air to both ends (upper figures). Similarly, within a total contact socket (lower middle), no edema will develop in the residual limb. In an open-end socket (lower right), the constricting force during weight bearing will reduce venous and lymphatic return, thus inevitably result in chronic distal edema and even verrucose hyperplasia.

In open-end socket design, compression occurs mostly around the proximal area of the residual limb while no contact occurring in the distal end. The proximal constriction will cause shrinkage in the proximal but swelling (edema) in the distal portion, as shown in the illustration (*Figure 2*).

Normally, the surface layer of the skin (dead cells with keratin) is constantly removed by natural actions such as friction against clothing or washing. If the

keratin is not removed under certain conditions, for example, inside a fracture cast or an open-end prosthetic socket, it accumulates, growing thicker and thicker. As keratin becomes thicker, drier and less flexible, edema in the surrounding areas or weight bearing during walking might stretch it to tear. Tearing of the thick layer of keratin along with underlying epidermis leads to oozing and bleeding. With increased moisture, secondary infection sets in and the soft tissue around it becomes red and inflamed. This has a hyperkeratotic (too much keratin) wart-like appearance: verruccose hyperplasia (Figures 3 & 4).

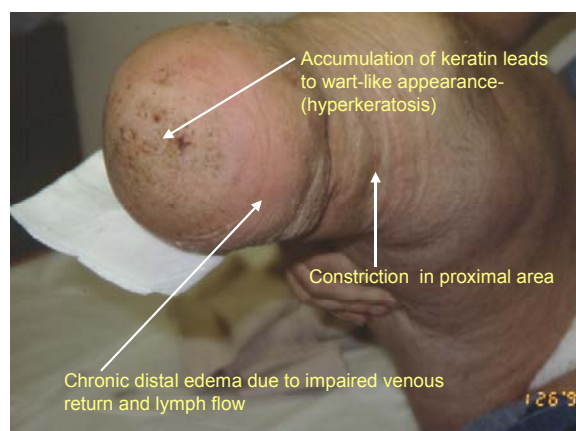


Figure 3. Verrucose hyperplasia is seen as a result of long-term use of an open-end prosthetic socket. The typical appearance includes constriction marks on the proximal area, chronic distal edema due to impaired venous and lymphatic flow, and thick, wart-like skin condition.

Treatment of verrucose hyperplasia includes: 1) Controlling infection with oral and topical antibiotics based on the culture and sensitivity test of the drainage, 2) Softening the hyperkeratotic mass with keratotic agent, such as 6% salicylic acid in cream or petroleum base, and, 3) Applying total contact compression dressing to the residual limb (using removable rigid dressing, which will be described in detail in a future Technical Brief). When distal edema improved, provide a new prosthesis with a total contact socket.

Consulting with a dermatologist is advised for proper treatment for severe verrucose hyperplasia, which might include:

1. Soak the stump in 1/40 Burrough's solution (one tablet of Domeboro in a quarter of water) for 15 minutes twice a day.
2. Wipe with sterile gauze.
3. Then apply 6% salicylic acid in Acid Mantle cream for half an hour to one hour, twice a day.
4. Wipe with sterile gauze and apply Neosporin cream then dry sterile dressing, twice a day.

Again, the primary cause of verrucose hyperplasia

is lack of compression in the distal area and excessive constriction pressure in the proximal area of the residual limb in an open-end socket. This dermatological problem is rarely seen in patients that have been fitted with a total contact socket.



Figure 4, A patient with distal edema and severe verrucose hyperplasia due to lack of total contact in the socket and tight supracondylar suspension strap (photos provided by O.Quintanilla, ISRI, San Miguel, El Salvador).

Reference

Levit, F: Skin problems in amputees, Chapter 31, Atlas of Limb Prosthetics, C.V. Mosby Co., 1981.

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