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Prevention of Foot Blisters

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Abstract:

Foot blisters are the most common medical problem faced by Soldiers during foot march operations and, if untreated, they can lead to infection. Foot blisters are caused by boots rubbing on the foot (frictional forces), which separates skin layers and allows fluid to seep in. Blisters can be prevented by wearing properly sized boots, conditioning feet through regular road marching, wearing socks that reduce friction and moisture, and possibly applying antiperspirants to the feet.

Introduction:

This is the first of what will be a regular column that will inform you of scientific findings and practical suggestions on how to prevent injuries. Your author served in the military for 24 years, first as an enlisted wheeled vehicle mechanic, then as a medic, and finally as a Medical Service Corps officer working in medical research and development. For 21 years after military retirement, I worked in research and public health at the Army Research Laboratory, Army Institute of Public Health, and Army Research Institute of Environmental Medicine. For 25 years, I was involved almost exclusively with issues related to injury prevention. I hope to convert much of what I and others have found into practical advice that might be useful to Special Operators. This first column discusses foot blisters, which is the most common medical problem faced by Soldiers during foot march operations. Blisters may seem like minor annoyances and they often are, but painful blisters can slow down or totally stop a Soldier. Broken blisters are open wounds subject to infection in the field because of the difficulties keeping out dirt and debris. Foot blisters can limit tactical mobility and consume mission time, especially if a Soldier becomes a major medical problem.

Causes of Foot Blisters

Friction causes foot blisters. Even if your boots fit well, some parts of the boot will press harder against your foot than other parts. These “pressure points” are where friction occurs. As you walk, your foot will move very slightly inside your boot, and this sliding causes shearing forces at the pressure points (Figures 1 and 2). Your skin can tolerate a lot of frictional shear force but, like any other material, the skin has its limits. If the shear forces are great enough and you take enough steps, the repeated pressure and rubbing will cause mechanical fatigue and your skin layers will separate. When the skin layers separate, body fluids enter the split and you have a full-blown blister. If you continue to walk without treating the blister, you can tear off the blister roof because the now-elevated blister area will still be subjected to shearing forces at the pressure points. Sweat, carrying loads, and faster walking make the situation even worse. When you first start to walk, your feet are usually dry. This initially reduces friction because you shed skin cells that provide a dry lubrication, much like graphite. However, as you continue to walk and begin to sweat, the moisture holds the loose skin cells in place because of surface tension. This increases friction and makes blisters more likely. With an increase in load or speed of march, more forceful movement of the foot inside the boot will increase the effect of friction. Greater loads may also cause the foot to expand, increasing the number of pressure points inside the boot.

Prevention of Foot Blisters

Proper boot sizing, foot conditioning, particular types of socks, and antiperspirants can reduce your chances of getting blisters. Blisters occur most often in feet that have not been properly conditioned. Research studies show that skin adapts to repeated frictional effects. These adaptations include thicker skin, more rapid replacement of the outer skin layer, and improved adhesion between skin layers. Skin adaptations occur in proportion to training. The likelihood of blisters decreases if you train with loads and over distances you expect to encounter on tactical missions and exercises.

Socks

Particular types of socks may also help. A Marine Corps study looked at three types of sock systems: a standard green combat boot sock (wool-cotton-nylon-spandex combination), the standard green combat boot sock with a liner sock consisting of polyester (i.e., a sock that “wicks” away moisture), and a prototype outer sock consisting of a wool-polypropylene combination worn over the same polyester liner sock as that of the second system. Blister cases requiring medical attention (i.e., serious ones) occurred with greater frequency in the Marines wearing the standard military sock compared with the Marines wearing the prototype sock with the liner (24% versus 11%) or compared with Marines wearing the standard military sock with the liner (24% versus 9%).

The polyester sock presumably removed sweat more rapidly while the thick sock presumably reduced friction.

Antiperspirants

Sweat can be considerably reduced or eliminated by using antiperspirants. In one study, an antiperspirant containing 20% aluminum chloride hexahydrate, a common ingredient in underarm deodorants, or a placebo was studied during a road march performed by U.S. Military Academy Cadets at West Point, New York. Cadets applied the preparations to their feet at least three consecutive evenings before a 21-km road march, during which they carried a total load of about 72 lb. Twentyone percent of cadets using the antiperspirants experienced blisters compared with 48% of the cadets in the placebo group. However, skin irritation was reported by 57% of Cadets using the antiperspirant but only 6% of cadets in the placebo group. This study suggests that antiperspirant may be an effective method of reducing foot blisters during road marching, but many users may have problems with skin irritation caused by the active ingredient. It may be possible to reduce skin irritation by using a lower concentration of aluminum chloride hexahydrate or altering how often the antiperspirant is used (i.e., every other night or every third night). A common sense approach is to stop using this preparation if irritation does occur. One of the best advantages of antiperspirants is that once you achieve the antiperspirant effect (after 3–5 days of applications), you can maintain it by future applications of about once a week.

Additional Information

Army Field Manual (FM) 21-18 (Procedures and Techniques of Foot Marches) contains additional information on treatment of foot blisters, general foot care (Appendix C), and physical conditioning for foot marches (Chapter 5). The references at the end of this article contain more technical details for medical personnel.

Summary

To avoid blisters, first and foremost, select properly sized boots for your feet. Break in the boots, gradually at first, with ever-increasing walking or marching distances with a light load. Then condition your feet through regular road marching using loads, distances, and speeds similar to those you expect to encounter in regular missions. Use friction-reducing socks and socks that will “wick” away moisture. Antiperspirants applied to the feet several nights before a march (and repeated at least once a week) will also help, but if you experience irritation from the antiperspirant, spread the treatment out over a longer period or discontinue its use. Changing wet socks during a march may also be a good idea because you will be reducing moisture around the foot. Use the principles of blister prevention: wear properly sized boots, condition your feet, reduce friction, and reduce moisture.



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