FREEDOM from Friction

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MORE RIGOROUS RESEARCH IS NEEDED, BUT CASE STUDIES SHOW THAT PROPER FRICTION MANAGEMENT CAN PREVENT BLISTERS AND REDUCE EXCESSIVE CALLUSING

What three things do a basketball player, firefighter, ballroom dancer, and person with a diabetic foot ulcer have in common? Friction, friction and more friction. Scientifically speaking, friction is the force that resists the relative motion or tendency of motion of two bodies in contact. However, it is better known as the rubbing of one surface against another. It is this repeated rubbing (repetitive loading) that causes skin irritations, abrasions, blisters, and calluses.

Over the past year, our team has been working with several athletic teams to explore the usefulness of friction reduction and management in areas where skin is at risk from rubbing. Specifically, each athlete was asked to use a low-friction interface material. The interface material, also called a patch, was placed on the inside surface of the shoe in an area where rubbing occurs. The results are worth sharing.

Success Stories

Case #1: Does reducing friction reduce the incidence of skin trauma? Ninety football, 26 soccer, and 16 volleyball players from a division II university participated in this trial. The purpose was to evaluate the efficacy of friction reduction in blister prevention. Each team was told to apply friction management patches when they felt a hotspot developing (Figure 1). Patches were applied on the inside of the athlete's shoes, not on skin. Of the 132 players participating in fall sports, 40% (52 athletes) requested friction intervention. Eighty-one percent of those (42 players) applied the low-friction interface patches in their shoes to prevent the hot spot from becoming a blister. The other 19% (10 players) already had a blister at the time they applied the patches. None of the 42 athletes that applied low-friction interfaces at the hot-spot stage went on to develop blisters in those locations. Six of the 10 players that developed a blister prior to friction intervention required no additional skin treatment.

Figure 1. Low-friction interface patch applied to the toe area of a soccer shoe insole.

Case #2: Does reducing friction decrease blister healing time? A certified athletic trainer (ATC) for another division II university evaluated blister healing time using his usual skin application products alone and compared it with the results from using his usual products in conjunction with friction management patches in the shoe. For this experiment, four soccer players were selected based on their blister-development history.

Without friction management, blisters developed as predicted on the Achilles heel area (bilaterally) for all four players. Blisters were approximately nickel-to-quarter sized. All blisters were treated with the ATC's usual skin products. Each player also received friction management patches in the heel area of one shoe and not the other (Figure 2). After 3 to 4 days, blisters paired with friction management were healed and comfortable enough for all four players to no longer use skin products on those blisters. After approximately 10 days, the blisters which received skin treatment alone still required ongoing care to maintain reasonable comfort. At that point, the athletes demanded low-friction interface patches in the heel area of both shoes.

Figure 2. Low-friction interface patch applied to the heel area of a soccer shoe.

Case #3: Does reducing friction help manage excessive callusing? A National Basketball Association (NBA) team participated in this friction reduction and management trial to evaluate the efficacy of friction reduction in the management of calluses. Basketball players at all levels are notorious for callus development across the metatarsal heads. Callus development differs from blister development in that it

happens over a longer period of time. Callus development is a natural protective mechanism in response to friction and is usually considered positive.

Calluses on the feet of athletes are often problematic and painful as they become excessively large, hard, and thick. The most common method used to manage problematic calluses is shaving. Prior to installing low-friction interface material in their shoes, this group of NBA players, on average, required their calluses shaved weekly. After placing interface patches in the metatarsal-head area of several players, callus production became less prolific—stretching out the time between shavings from 1 week to about 4 weeks (Figure 3). After using friction reduction material for 3 months, player's calluses continue to be under control and require minimal attention.

These three cases do not qualify as rigorous, well-controlled studies, but they do provide glimpses of the benefits of friction management.

Not All Friction is Bad

We use the term friction "management" because friction loads on the skin are altered (reduced) in only certain areas of contact. That is, only in specific areas where the skin indicates through redness, pain, blisters, or excessive callusing that rubbing (friction) loads are excessive. On the other hand, in areas where friction loads are not great enough to cause skin irritation, friction loads are usually useful to "grip" or stabilize the shoe. Thus, not all friction is bad.

Figure 3. A low-friction interface patch applied to the metatarsal-heads area of a basketball shoe insole slowed callus production in one case study. Time between callus shavings stretched from 1 week to approximately 4 weeks.

Wearing a silk or nylon sheath under a standard sock reduces the friction coefficient equally over all areas of the foot. Such a "global" approach may loosen too much of the grip between foot and shoe (good friction). Petroleum jelly, oils, and creams can reduce friction in at-risk areas but that effect is short lived, not to mention messy. The hydrating and softening effect of oils and lotions on the skin can actually lead quite quickly to an elevated skin trauma risk.

The Future

Low-friction interfaces were first introduced in the orthotic and prosthetic industry. The low-friction interface technology makes orthoses and prostheses more comfortable so wearers can tolerate higher levels of orthopedic support and/or function at higher levels for longer periods. At this time, friction management is making a jump to the pedorthic and athletic arenas.

Ten years from now we expect friction management in the athletic arena to be so common and proactive that blister incidence will drop by at least 50%. Functional limits for people with prostheses will be set more and more by cardiopulmonary capacity rather than by residual-limb skin comfort. Callusing on the feet of people with peripheral neuropathy will be controlled largely by friction management materials strategically located in shoes. The onset of foot ulcers and amputations in that population will be delayed several years.

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