

# Friction Blisters of the Feet: A New Paradigm to Explain Causation

Rebecca Rushton, Douglas Richie; Friction Blisters of the Feet: A New Paradigm to Explain Causation. Journal of Athletic Training. 8 January 2024; 59 (1): 1–7.

## The Established Paradigm

The **Heat-Moisture-Friction** paradigm seems intuitive:

- The exercising foot gets hotter (*heat*)
- This creates sweat (*moisture*)
- This moisture causes the sock/shoe to rub the skin (*friction*)

However, the above interpretation is incorrect. Increased friction does not cause more rubbing, it causes less rubbing. The **two contrasting definitions of friction** are to blame here (rubbing vs resistance to rubbing). Therefore, this paradigm should be abandoned as it is misleading. Indeed, it is an oversimplification of the real process, ignoring fundamental elements of the blister injury.

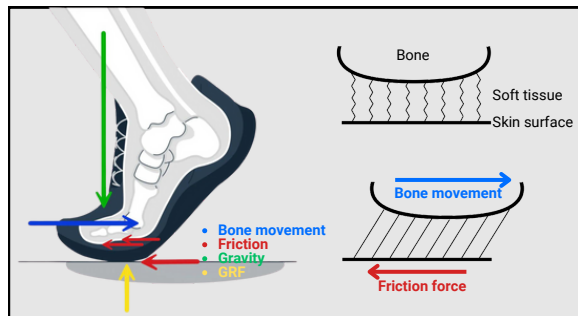


Figure 1: The movement force that leads to blister formation comes from within the foot, from the bones. As the bone moves, friction force resists this movement at every material interface, keeping the skin surface stationary, a necessity for efficient gait. This mismatch in movement between skin and bone is taken up by the soft tissues undergoing shear deformation - the cells and their connections stretch and distort (see Figure 2).



There is a movement force associated with friction blisters, but it is NOT something rubbing the skin surface. The movement is coming from the bones within the foot.

## The New (Renewed) Blister Paradigm

It has been known that friction blisters are caused by **Repetitive Shear Deformation** since 1955 (Naylor), 1966 (Sulzberger) and certainly since 1973 from the work of Comaish. However, this fact has been lost in translation due to the friction definition issue.

### How and Why Foot Friction Blisters Form

1. Bones move within the foot every step (this is normal)
2. Skin surface doesn't immediately follow (**due to friction force**)
3. Soft tissues in between skin surface and bone stretch and distort (**shear**)
4. When shear is excessive in frequency and/or magnitude, a tear occurs under the skin surface - the desmosomes that hold skin cells together fatigue and break and the skin cells die (intraepidermal tear)
5. Fluid fills the injured area causing the skin surface to bubble up (blister)

### Why Is This Important?

#### Cause informs prevention

Understanding the determinants of **repetitive shear deformation** opens up previously ignored opportunities for blister prevention and treatment, and helps identify the limitations of modalities in popular use.

### Mechanisms of Blister Prevention

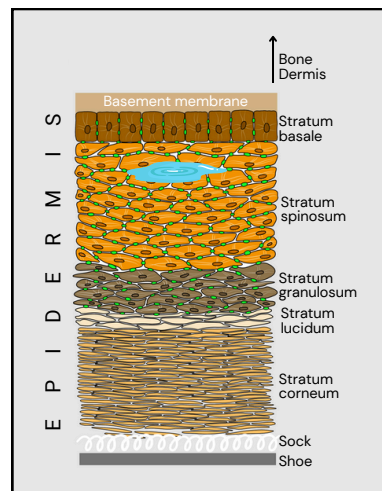
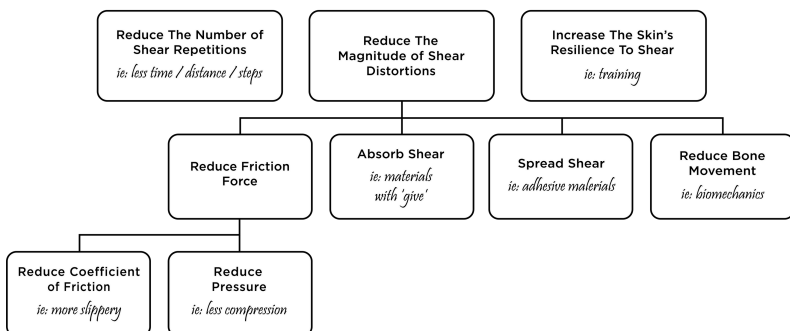


Figure 2: The layers of the epidermis (not to scale). Of all the tissue layers between skin and bone, the deeper section of the stratum spinosum is the weak point to repetitive shear deformation. The mechanical failure heralding the initiation of the blister injury occurs here. Desmosomes (green) fracture causing skin cells to die. The void created slowly fills with fluid (blue) over 2 hours.

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