

## All About Blisters

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**On the afternoon on June 30, 1924, Calvin Coolidge Jnr, the son of the 30th President of the USA, Calvin Coolidge, played a game of tennis with his brother John Coolidge. Because he wore tennis shoes without socks, Calvin Jr. developed a blister on his right foot, which progressed into blood poisoning and was the cause of his death on July 7, 1924, less than three months after his sixteenth birthday.**



In 1994, blisters played a huge part in the loss by defending US Open champion Pete Sampras in the 4th round to relative unknown Jaime Yzanga. Blistering of the feet was to plague Sampras for the remainder of his career. At the 89th Australian open in 2001, Sampras was again flattened by blistering, and again lost in the 4th round to the unseeded Todd Martin.

Whilst we often trivialize blistering, these 2 examples underline that it can be quite a serious sports injury, so it is worth delving into the causes and treatment in detail.

So.. why is it worth protecting the skin.. why is it so important?

### THE FUNCTION OF SKIN

The skin is often called the body's largest organ and is the structure responsible for the prevention of loss of body fluids, and it acts as a barrier against the entry of toxic chemicals and microorganisms. The dryness and constant desquamation of skin, along with normal skin ... and the fatty acids of sweat and sebum, affect a natural defence zone against infection by microorganism.

**Langerhans cells** are present in the epidermis and they have an antigen-presenting capacity that may play an important role in delayed hypersensitivity reactions. They also have a role in immunosurveillance against **viral infection**. Langerhans cells interact with neighbouring keratinocytes, which secrete a number of immunoregulatory cytokines, and epidermotropic T-cells which forms the skin immune system known as SALT (skin associated lymphoid tissue). Melanin is the pigment of skin in it has a primary role in protecting against ultraviolet radiation. The skin, because of its rich innervation, is a huge sensory receptor for heat, cold, pain, touch and tickle and is a vital part of the body's temperature regulatory system.

The skin also plays a critical role in calcium homeostasis, by synthesising vitamin D3 (cholecalciferol) from dehydrocholesterol via the action of ultraviolet light. Vitamin D3 is then hydrolysed in the liver and kidneys to 1, 25-dihydroxycholecalciferol, the active form of Vitamin D. This anti-rachitic vitamin acts on the intestine increasing calcium absorption as well as on the kidneys promoting calcium resorption.

So.. the skin is a very important structure!  
 What happens when things go wrong?

## Blistering

Blisters (Bulla) are described as a circumscribed elevated lesion **greater than 5 mm in diameter** (distinguished from a vesicle which is less than 5 mm in diameter) and they have many common causes including contact with a primary irritant, allergic contact dermatitis, sunburn, insect bite, viral infection, e.g. herpes simplex, varicella (or drug eruption).

Of course in sport we know blisters to be the end point of a failure of skin integrity resulting from abnormal or excessive friction of the skin surface with another. Initially there is a separation of the upper layers of the epidermis from the superficial layer of dead cells. The space between the two layers then fills with a transudate of serum, with the skin surface left intact. **The foot is a very common site for blistering** in sport as blisters are precipitated in moist, somewhat immobile skin, a description that matches several sites on the foot. In addition, sports shoe provide an ideal environment for increased friction of the shoe/skin interface, especially when new or

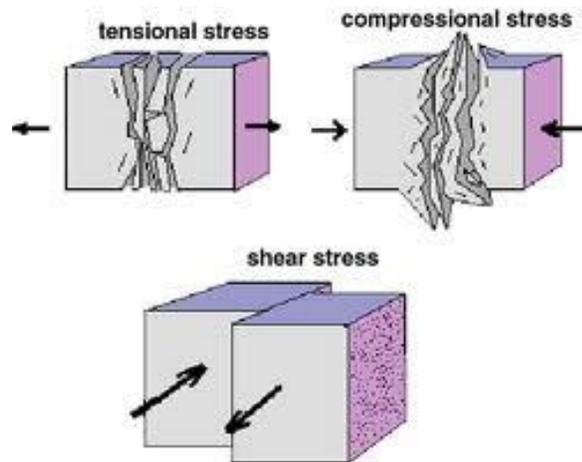


used for unaccustomed or prolonged activity. This photo demonstrates a large and painful blister sustained by a marathon runner during the Sydney Olympic Games in 2000.

## Treatment

By far the most effective treatment for blistering is the **institution of prevention strategies**.

Blistering is caused by friction and, especially shear, which may be either translational or rotational. The reason blistering is such a problem in sports like football, tennis and basketball is that multi directional sports such as these impart very high shear loading stresses. The image below demonstrates the difference between shear and other loading.



This is especially important with regard to new athletic footwear, and it is wise to observe a wear in period if there has been a predisposition to blistering. In this regard, the underrated property of shoe fit is most important. Selecting the correct shoe for the proposed activity and for the foot type is a vital preventative measure. Because one of the primary functions of sweating is to increase friction at the skin/surface interface, control of excessive/abnormal sweating is most important.

Strategies to reduce sweating include:

- Choice of material for footwear and socks. Many of the new synthetic fibers have far superior “breathability” characteristics and moisture wicking capabilities than nature fibers. Look for these materials in athletic footwear and socks. Mesh uppers, especially in running shoes will also allow airflow temperature and moisture exchange. An added benefit is weight reduction in the running shoe.
- Anhydrotic powders offer good protection against excessive sweating, especially the anti-cholinergic agents that act on the sweat gland itself. Dilute (Just Pink) foot bath solutions of condis crystals (potassium permanganate) is an old but reliable anhydrotic technique.

Many authors advocate the wearing of two pairs of socks for blister prevention; however this may compromise correct shoe fit and other preventative measures may be more appropriate.

One of the biggest issues with blistering is movement of the foot within the shoe, especially "jamming" forward, which also is a big cause of black toenail. Many people truly are 'between size' athletes and struggle to get a perfect fit. Inevitably these athletes go for the smaller rather than larger sizing. In my opinion this is a flawed strategy, and the athlete should always err on the larger size. Whilst slippage is then an issue, this is easily remedied.

Simply glue crescent shaped pieces of spenco insole, with the black (neoprene) side toward the foot, on both medial and lateral instep, as well as the tongue. Spenco used this way is extremely grippy, and so will not allow the foot to slip at the heel or move forward in the shoe. In addition, because of the closed cell nature of spenco, it offers very high shear stress protection. I have used this technique over many years with very good effect. Other shear protecting materials can also be used over vulnerable sites as an extra precaution.

If a blister has formed, the two primary treatment goals are **infection control and pain control**. Perhaps the most effective method of preventing infection of a blister is to maintain the delicate cover and "roof" of the blister.

For this reason, **a blister should never be "popped"**, as this will provide a portal for opportunistic microorganisms and infection may result. It is appropriate however, with larger blisters, to **aspirate fluid under antiseptic conditions** with a sterile hypodermic needle. Significant blisters may need to be aspirated hourly until the filling process ceases. Blisters treated in this matter should be followed up with skin disinfection using Povidone-iodine or Chlorhexidine based products. Because the skin is so richly innervated, blisters can be very painful and so **pain control is important**. Pressure relief padding gives good relief in the short term and if the athlete is required to return to the field with a painful blister, application of topical anesthetic (provided there is no major skin denudement) may be helpful. If the blister has a large tear, like the photo below, it should be carefully "deroofed" and the base thoroughly cleansed with an antiseptic agent.

Antibiotic ointments such as Bacitracin or dressings e.g. Bactigras may be a worthwhile precaution in these cases.



**Long term strategies for blister management include:**

1. Removal of any or all sources of abnormal pressure and friction
2. Correct shoe selection and cautious wear in time
3. A thin layer of petroleum jelly can be most helpful, especially for endurance events like marathon running
4. Anti-shear insoles such as Spenco, provide excellent protection from blistering on the plantar surface of the foot. This closed cell neoprene material is a very effective shear stress reducing compound. It may also be glued into areas of a shoe exhibiting high skin to shoe shear, for example around the heel.

There are a variety of very effective dressing materials available either specifically for blistering or derived from burns therapy. They include the hydrocolloids [Compeed](#), [Duoderm](#) (convaTEC Princeton, New Jersey), and [Spenco Second Skin](#) (Spenco Medical Corporation, Waco, Texas) as well as [Opsite](#) (Smith and Nephew United, Largo, Florida). These may be applied directly to the skin and held in place with hyperfix or a similar mesh tape. They provide excellent protection from blister recurrence and are also a primary agent in acute blister care.

Finally, address faulty foot biomechanics. Some foot types do predispose to blistering, for example cavus feet and plantarflexed 1st ray. These feet are rigid and have an inherent inability to attenuate shock and shear. It is unlikely the treating practitioner will achieve satisfactory resolution of chronic blistering until the biomechanical abnormalities are corrected.

References

1. This article was sourced from <http://www.bartoldbiomechanics.com/articles/blistering-what-is-is-and-how-to-manage-it-properly>
2. "President's son, Calvin Jr., 16 dies". New York Times. July 8, 1924. Retrieved 2010-06-26