FOOTWEAR

Tennis is played on a variety of surfaces, including clay, carpet, grass, and hard court. These main surfaces are reflected by the Grand Slam tournaments, which are played on hard court (US Open and Australian Open), red clay (Roland Garros), and grass (Wimbledon).

The various surfaces foster different playing styles, e.g. serve and volley on grass and carpet, baseline on clay, and an all-court/aggressive baseline game on hard court. Such is the variety of tennis surfaces, the problem in providing appropriate footwear is not one that can be solved with a single solution, so shoe manufacturers have developed shoes suited to different surfaces.

The shoes of the player need to suit the surface characteristics to reduce injury risk and to enhance performance. From a design perspective, these factors are not mutually exclusive, that is they are inter-dependent to a certain extent, an inter-dependence that can result in a design “conflict”.

Tennis movement patterns are relatively complex, involving forward, backward, sideways, rotational and sliding movements at a variety of speeds. Tennis is therefore demanding on footwear, and selection of the correct shoe-surface combination is crucial to striking an appropriate balance between performance enhancement and minimisation of injury risk.

Shoe selection & performance enhancement

It is clear that the frictional characteristics of the shoe-surface interaction need to strike an appropriate balance between being too high and too low, each of which has its own problems.

The two materials in contact primarily determine shoe-surface friction characteristics, but the surface roughness and tread pattern of the shoe must also be considered (figure 1).



Figure 1. A selection of tread patterns.

While the sole of the shoe on the left of this group may be appropriate for a surface such as carpet, it would prove disastrous on clay, as the loose particles on the surface would act like tiny ball bearings and lower the coefficient of friction (COF) to a point where a player's ability to accelerate and decelerate would be severely affected.

A shoe designed for clay courts should have a treaded sole to allow the loose particles to be caught within the tread so that the COF is determined to a greater extent by the nature of the surface underlying the particles.

A potential conflict exists between the optimisation of the frictional characteristics of the shoe-surface interaction when moving in a straight line and when turning. While sufficient friction to start and stop quickly is necessary when moving in a straight line, minimum friction is beneficial when pivoting, thus allowing rotation to occur as quickly as possible. The soles of some shoes contain circular pattern under the head of the first metatarsal (the ball of the foot) to facilitate turning.

There is often a conflict between what might be considered the two most important biomechanical functions of a sports shoe: impact attenuation and rearfoot control. That is, softer-soled shoes that attenuate impact forces effectively also allow the rearfoot to move relatively freely, excessive motion of which causes eversion injuries.

It is also known that, in general, shoes lose around 30% of their impact attenuation properties after modest use (the equivalent of about 500 miles), so they should be replaced regularly.

How to select a tennis shoe

1. The potential conflict between the requirements of impact attenuation and rearfoot control may be overcome by the selection of shoes with stiffer heel counters, a less compliant (firmer, harder) midsole and a wider heel base at the outsole.

All of these tend to control rearfoot motion without necessarily increasing impact forces or exacerbating subtalar joint movement.

2. Change the shoe at regular intervals. This will prevent the exacerbation of impact forces due to the loss of their impact-absorbing qualities.

3. Ensure the shoes are the correct size. Feet tend to get bigger as the day goes on (due to supporting the body's weight), so the late afternoon is generally the best time to try shoes on.

4. Select the shoe that is appropriate to the surface being played on. For example, a smooth-soled shoe is unlikely to be effective on clay, whereas on some surfaces a shoe with a large contact area will be an advantage.