

Wonder or 'wounder' shoes on the tennis court

About the only piece of equipment that takes more of a pounding than shoes on a tennis court is the ball itself. Professional players are getting faster and stronger—in both genders—and that means today's tennis footwear must live up to expectations. Foot injuries are the most common cause of crowd disappointment and player withdrawal on the professional tennis circuit. And the reconstructive surgery costs of repairing some 200,000 anterior cruciate ligament injuries in the US alone are already running at over half a billion dollars.

Tennis is a traditional sport but that doesn't mean the equipment used for it has to be so. Colour is playing an ever infringing role on Wimbledon's 'all-white' rule and manufacturers and players alike are finding new ways to add flash to their dash both in their clothing and definitively 'in their shoes'. Although the biomechanics of the sport have not fundamentally changed over the decades, surfaces have become more varied and in, the instance of synthetic surfaces, harder and more abrasive. There is a monumental difference between the grass courts of Wimbledon, the red clay of Roland Garros and the synthetic hard courts of Flushing Meadows. They all play differently and demand different levels of traction and cushioning from footwear. The need to protect the feet and prevent injuries, particularly in young players, has led leading sport shoe companies to conduct rigorous tests and trials, both in the gait laboratories and on the tennis courts around the world.

Tennis shoe requirements are broken down into specific segments according to:

- Durability and sole construction
- Determinants of foot type
- Lateral and medial support
- Shock absorption and cushioning
- In-shoe climate and temperature
- Considerations of fit

Durability and sole construction

The rubber compounding used in top quality tennis soles is critical both in terms of durability and traction. Rubber specialists Goodyear and Vibram have gained a foothold with several leading sport shoe brands by introducing improved compounds for different surfaces.



Performance tennis shoes, especially for an aggressive or attacking style of play—as opposed to classical or defensive playing styles, must “give” enough to allow for medial and lateral sliding, which varies from extreme on softer clay courts to minimal or abrasive on harder surfaces. The key to successful injury prevention in terms of outsoles is the word ‘optimal slide’. Because tennis court surfaces vary from soft grass to hard cement, the ‘coefficient of friction’ is the interface between the court surface and the shoe’s outsole. Tread patterns on outsoles may include ‘zoned’ areas with a herringbone pattern, bi-level nubs and high abrasion resistant areas for optimal wear. Tennis players are notorious for wearing holes in the toe area, either from their service action or by using the ‘non-plant’ foot as a ‘drag’ balance when hitting a backhand shot. Nike has just introduced its latest answer to this problem of durability with its new Air Zoom Revive—which is two shoes in one. It features a removable thermoplastic urethane inner shell and a strap-on rubber outsole. When the rubber outsole is worn out, it can simply be removed and replaced with a second outsole that comes with the original purchase.

Everyone has their type

As in other sports today, with the possible exception of gymnastics, leading players are faster, stronger and heavier. The foot can be categorised in several ways such as by arch height, race, and by width. In tennis shoes, foot types can be categorised into supinated – with the wear pattern predominantly on the lateral border of the heel and forepart; pronated – with shoe wear mainly on the medial side of the forefoot; and neutral – with even wear on the entire outsole surface.

Players in the supinated category (about 30% of tennis players) tend to be high-arched and require adequate to extra support on the lateral side of the sole and upper. The quick side-to-side movements in tennis make lateral support and the prevention of ankle rollover (leading to ankle sprains) a major consideration in shoe selection in this category. Adequate cushioning is also important for the more rigid high arched foot.

For players who tend to pronate excessively, a relatively wide forepart with stable flat bottom is required. Many over-pronators (about 60% of tennis players) may have low to flat arches, which is associated with overuse injuries in this category. Motion control in the shoe or an additional pronation control insert (or orthotic) will normally help the player in this foot-typing category. A good heel counter is a ‘must have’ component in good tennis shoes and many brands ‘lock-in’ the heel counter with a high profile mid-sole side wall.

The neutral segment (about 10% of players)



encompasses players with an ‘ideal’ foot type, or rather, those that wear their shoes evenly and are in the elite athlete category. Most players in this segment have a moderate arch height with static weight distribution of about 50% on the heel (calcaneous) and 50% on the balls of the feet (metatarsals) and toes (phalanges).

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 K-Swiss

Lateral and medial support

Regardless of the foot type, the tennis shoe must support the whole of the foot. Beginning with the sole unit, construction is either cement or direct injection using an EVA or PU midsole with rubber outsole. Due to machinery costs, rather than performance or player preference, and the large-scale shift of manufacturing to the Far East, cement construction predominates for tennis shoes. PU, due to its denser structure, is still regarded as a stronger and more supportive midsole material than EVA. Both materials, combined with a rubber outsole, are used in unit form with cupped side walls to ‘cradle’ the foot from heel to toe.

All of the control in a shoe starts at the heel. Performance tennis shoes must have a firm heel counter with pre-moulded thermoplastic the preferred choice rather than chemi-sheet material. Some players prefer a semi-cut or mid-cut upper for better medial and lateral support, as long as it is comfortable and does not rub on the mallioli (ankle bones). Tennis midsoles and outsoles may be slightly posted (or wedged) at varus or valgus angle of approximately 2° to better support the lateral or medial aspect of the sole. Torsional rigidity is another important sole feature to add control to the shoe. Midfoot shanks or bridges are often incorporated into the midsole to compensate for the lack of a rigid lasting insole board. Upper features to improve

stability include height of the topline, asymmetrical quarters, a wrap-up toe guard, exoskeleton support straps and secure lacing systems.

A soft landing

With hard surfaces and quick stops and starts, tennis can jar the body, particularly the feet, ankles and knees. In addition to a sturdy upper to hold the foot snugly in place, adequate underfoot cushioning is also a necessity for all categories of players.

In the May/June 2005 issue of *WSA*, we covered a study conducted by CTC to evaluate the vertical component forces in reaction to the ground. This study defined that the presence of a peak impact (the shock of the heel versus the hardness of the ground) is equivalent to three or four times the body weight during a running motion and up to ten times the body weight when the leg is fully extended at impact. Cushioning is therefore essential and devices, such as air bags which were originally conceived and used in running shoe technology, have since been incorporated into tennis footwear. Whilst on grass and soft clay courts cushioning is not as important, on hard courts it is vital. Baseline players also typically need more cushioning than serve-and-volley types.

Breathing easily in a pleasant climate

The breathing function of the skin is especially important for the foot, which contains many thousands of sweat glands and pores. Housed inside a tennis shoe for either hours of practice or during a five-set match on a hot synthetic surface, the temperature inside a tennis shoe can quickly reach over 160° Fahrenheit (72°C). K-Swiss has recently introduced a heat-reducing midsole material in its new Glaciator SCD, to deflect the surface heat of the court away from the feet and most leading tennis shoe brands have incorporated a moisture wicking feature into the lining material. A pair of adult feet produces about half a pint of perspiration on an average active day; playing strenuous tennis can double the amount of liquid generated. Adidas has addressed the 'perspiration issue' with its ClimaCool lining feature for better moisture control, whilst K-Swiss has added a Fautex collar lining technology to wick away moisture from the foot.

A fitting thought

If determining the correct size and shoe fitting is important in all shoe categories – it is paramount in fitting a tennis shoe. Because the foot is subjected to such extreme stress and pressure inside the shoe, the footwear must protect, cushion and support the foot under all playing conditions and on all surfaces. In

addition to matches that can last several hours, top tennis players practise for many hours each day to perfect their game. Blisters and nail disorders (Hematomas) are common amongst tennis players and tennis shoes need to have well padded toe boxes with plenty of room to allow for the feet to expand as the temperature rises inside. A well-cushioned sock helps to absorb the shock and secure the foot, thus preventing shear or excess movement inside the shoe. A snug fit at the heel, arch and midfoot is required with plenty of toe room in the toe box. Buying a new shoe in the afternoon or evening, when the foot is fully expanded, is a good fitting tip as is trying on both shoes in the store. If consumers were prepared to 'do the leg work' and find the best fitting last for their feet, the results would be well worth it in terms of comfort and performance. Shoe sizing is not standardised and each brand has its own last shape and fit characteristics.

Brands on court

To meet the challenges and requirements of rapid and repetitive motion, there are many well designed tennis shoe models on the market, many of which incorporate the performance and injury protection features mentioned above. As in many categories of sport shoes, there are choices from the 'full-range' major brands – Nike, adidas, Puma and New Balance – to some excellent contributions from more 'specialised' brands such as K-Swiss, Prince, Wilson, Head and Fila. Although there is not an established 'one brand is best' in tennis footwear anymore than 'one shoe fits all', as one of the world's most injury-causing non-contact sports, it is comforting to know the latest in shoe technology has been incorporated into 'sport specific' tennis shoes to offer players 'optimal' performance combined with injury prevention. 



Adidas' Barricade IV has an EVA midsole and midfoot feather construction for a lighter and better cushioned toe.

 adidas