Sports shoes: a guide to shoe assessment and their suitability for patients

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The sports shoe can be evaluated as part of the overall assessment of the patient with musculoskeletal symptoms.

Figure 1. Anatomy of the sports shoe. This shoe has antipronation features of a dual density midsole wedge and a plastic bridge.

At a time when more people are taking up physical activity, musculoskeletal complaints may become a more common presentation in general practice. When evaluating a patient with a musculoskeletal injury, all possible contributing risk factors should be assessed. Extrinsic factors to ask about include the amount and type of sports training, the sports equipment used and the shoe worn. This article focuses on the sports shoe and provides a guide to assessing its suitability for individual patients.

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Anatomy of the sports shoe

The two main parts of the shoe are the upper, which covers the foot, and the sole, which provides the interface between the foot and the ground (Figure 1). These parts have several components.

The sole

The outsole

The outsole, which is the outermost layer on the external surface of the sole, is primarily involved in the provision of traction. Features of the outsole that can be found in more specialised shoes include cleats (e.g. in football shoes) and spikes (e.g. in sprinting shoes).

The midsole

The midsole, which is the section between the outsole and the upper, is involved in shock absorption and control of foot motion. It is one of the most important components of a sports shoe.[1]

The midsole is made from a synthetic polymer such as ethylene vinyl acetate. Encapsulated air or silicone gel can enhance its cushioning effect.[2,3] Shoe manufacturers have given names to their midsole materials and encapsulation methods – examples include 'HydroFlow' and 'MoGo' from Brooks, 'Gel' and 'Solyte' from Asics and 'Air' from Nike. Stability devices located on the medial side of the shoe and used to control pronation include a rollbar or torsion bar, which is comprised of stiffer material, and a higher density section, which is usually indicated by a coloured area (a dual density midsole).

Insole

The insole includes the sockliner and insole board or stitching. The sockliner is a cushioned layer that absorbs perspiration and can be removed to allow insertion of an orthotic or to be replaced. It provides minimal shock absorption and stability for the foot.

The upper

Materials used in the shoe upper include leather, which is durable and puncture resistant, transmits perspiration and can be treated to become waterproof. A synthetic material such as nylon weave or mesh is used more commonly than leather in running shoes; these materials can make the shoe lighter and improve breathability.[2]

Heel counter

The heel counter provides stability for the rearfoot. It needs to be firm for all foot types.

Toe box

Inadequate space in the toe box can cause the nails to be compressed into the toes and contribute to ingrown toenails. It can also exacerbate the pain of hallux valgus, metatarsalgia, and clawed and hammer toes.[4]

The last

The last is the foot model around which a shoe is constructed. The longitudinal shape of the last is thought to influence foot mechanics. A shoe with a straight last may provide more control for the pronated foot, whereas a shoe with a curved last may provide better flexibility and be appropriate for the cavus or supinated foot .[2] In practice, the curved last is not frequently used and is seen mainly in sprinting shoes. The semi-curved last is more commonly used and provides a balance between the straight and curved shapes (Figure 2). However, the midsole may be a more important factor in determining the ability of a shoe to provide cushioning and control foot motion.

Does the sports shoe suit the patient?

An approach to determining whether a sports shoe is appropriate for an individual patient is described below and summarised in the box on this page and in the Table. The summary box may also be of value to patients.

The patient

When assessing whether a particular sports shoe is appropriate for an individual, it is important to ask what it is used for. There are differences between shoes designed for running, court sports, football and cricket. Some practitioners advocate using a specialised shoe for a sport when that particular sport is played three or more times per week.

The patient's foot mechanics and arch type should be assessed. This can be complex, and the advice of a sports physician, sports physiotherapist or podiatrist can be very helpful. A specialised running shoe store can also provide advice.

Foot mechanics can be assessed while the patient is standing by palpating the head of the talus between the thumb and index finger. A talar head that is more prominent on the medial side indicates a pronated (rolled in) position. Conversely, a talar head that is more prominent on the lateral side indicates a supinated (rolled out) position. Symmetrical prominences indicate a neutral stance.

The patient's gait should be observed, from both behind and in front, looking for excessive pronation; lack of the normal pronation can indicate a supinated gait. A pronated foot is flexible and can transmit increased ground reaction forces to the lower limb. Alterations in lower limb biomechanics can also occur in pronation and this foot type has been associated with patellofemoral pain, Achilles tendinopathy and tibial periostitis. In contrast, a supinated, less mobile foot can result in poor shock absorption and be associated with stress fractures.[5]

Arch type is most simply assessed by looking to see if the arches are high (pes cavus), low (pes planus) or neutral. A low arch can be associated with pronation and a high arch with supination.

The shoe

The shoe should have a firm heel counter to provide stability for the rearfoot. This can be tested by compressing the heel counter with the thumb and index finger and checking for resistance to compression (Figure 3).

Figure 2. Sports shoes with a straight last (a, left) and a semi-curved last (b, right).

The midsole and heel counter can be assessed for stability by pressing firmly upwards on the outsole of the heel from below. The midsole should spring back quickly; if it returns slowly or the whole heel counter becomes squashed then it may be time to replace the shoes. Over time, the midsole of a running shoe loses

How to assess a sports shoe: a summary

- What is the shoe used for? The need for a sports-specific shoe should be considered.
- Is the heel counter firm and stable to lateral compression?
- Is the midsole firm and does it spring back when compressed?
- Is the shoe stable with torsional twisting?
- Does the shoe bend at the toe joints?
- Does the shoe suit the individual's foot type and gait?
  - The pronated foot type (rolling-in) needs a straight or semi-curved shaped shoe; medial stability or a motion control device may be needed.
  - The supinated foot type (rolling-out) needs a curved or semi-curved shaped shoe; no antipronation device is needed.
  - The neutral foot type prefers a semi-curved shoe, without antipronation devices or with mild stability features.
- How old are the shoes? Replacement of running and crosstrainer shoes should be considered after six to 12 months or after 800 to 900 km.
- Advice from a sports physician, sports physiotherapist or podiatrist may be helpful. A specialised running shoe store can also provide advice.

continued

Table. Features of sports shoes for different foot types

Shoe features	Pronated foot type	Neutral foot type	Supinated foot type
Heel counter	Rigid	Rigid	Rigid
Torsional stability	Required	Required	Required
Shank stability	Required	Required	Required
Midsole	Firm, dual density	Intermediate	Cushioned
Motion control and stability devices	Required	Mild stability or none required	Not required
Shape of last	Straight or semi-curved	Semi-curved	Curved or semi-curved

its ability to absorb impact force; consequently, the sports shoe is thought to have a finite functional lifespan. The recommended time to replace running and crosstrainer shoes is after 800 to 900 km or after six to 12 months.[3]

Torsional stability can be tested by observing whether the shoe maintains its form when its forefoot and rearfoot are rotated in opposing directions (Figure 4).

Shank stability is present if the shoe bends at the position of the metatarsophalangeal joints (Figure 5). Problems arising if the break point occurs at the midfoot or not at all include calf or toe plantar flexor overuse injuries. However, a stiffer sole may be advantageous in some situations – for example, for a patient with hallux rigidus for whom great toe metatarsophalangeal joint range of motion is painful.

For a pronated foot type

An additional feature of sports shoes for the pronated foot is a medial motion control device. A variety of dual density midsoles and other are available, and the appropriate choice will depend on the

Figure 3 (above left). Stability of the heel counter is tested by side-to-side compression and observing resistance to the deforming force.

Figure 4 (above). Torsional stability of a shoe is checked by rotating the forefoot and hindfoot in opposite directions.

Figure 5 (left). The break point of the shoe should generally be at the position of the metatarsophalangeal joints. This is demonstrated by pushing the forefoot of the shoe upward from below.

degree of pronation.[6] Some shoes manufactured for the pronated foot are still made with a straight last.

For a supinated foot type

Individuals with a supinated foot type are said to have poor shock absorption, but most of the high quality sports shoes available have good midsoles that will provide sufficient cushioning. A shoe with a curved or semi-curved shape is more appropriate than a shoe made with a straight last.

For a neutral foot type

A semi-curved shoe without motion control features or with mild stability features is appropriate for a patient with a neutral foot type and who exhibits the normal amount of pronation and supination during the gait cycle.

Sport-specific shoes

Football shoes have cleats, which are appendages attached to the external surface of the outsole that assist in traction with the playing surface. Blades and molded studs, both undetachable and 'moulded' in the manufacture of the outsole, are used for hard, dry grounds and by 'backs' in rugby union and rugby league. Longer screw-in studs are used when more traction is needed for wet ground and also by 'forwards' in rugby union and rugby league to assist with playing in the scrum. The midsole, as with all shoes, provides shock absorption and some stability, which is important for the footballer with a pronated foot type. However, some football shoes do not have a midsole, with players preferring the 'light' feel of this type of shoe, which is thought to increase the speed of play; some players believe they are able to 'feel' the ball better, especially in the kicking codes of soccer and Australian Football League (AFL).

There are differences between running shoes used for racing and training, and for different running surfaces. Sprinters race in light shoes with forefoot spikes and no midsole, whereas runners who race over longer distances use shoes that have some form of midsole. For training purposes, the desirable features of a sports shoe described above still apply.

Final comments

The sports shoe can be evaluated as part of the overall assessment of the patient with musculoskeletal symptoms. It is advisable to assess the shoe first, and then to consider whether it is appropriate for the individual. MT

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