How to Evaluate and Recommend Athletic Shoes

AAPSM reviews the latest in athletic footwear.

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A thletic shoe technology is an ever-changing entity. Recent technological alterations to running shoes are the result of extensive research and differing views about what is best for runners and athletes. Athletic shoes are as diverse as the people who use them; therefore, it is vital to understand the differences between the various types of shoes, such as those with cushioning, stability, motion control, and the numerous models that are available. It is also imperative for the podiatric physician to be aware of current trends in running shoes, including toning shoes, barefoot running, and minimalist running technology. Our goal as sports medicine podiatrists is to advise our patients as to the athletic shoe that will allow them maximum performance with minimal risk of injury and that is also biologically, anatomically, and sport-appropriate.

The American Academy of Podiatric Sports Medicine (AAPSM) utilizes a four-point system, both to study and then allow us to recommend shoes to our patients. The need for evaluation is crucial, now more than ever as we find ourselves having to choose among many different competing concepts and technologies—from companies moving to create shoes with ever-more biomechanical control and biomechanical correction, to companies designing minimalist shoes, to recommendations from some quarters that runners should simply go barefoot. It is important to keep in mind that competing ideas create improved footwear. We can surely provide technological information to our patients, but the real art of making recommendations lies in combining that information with an understanding of each individual patient’s unique needs and circumstances. AAPSM’s four-point system consists of reviewing the literature, reviewing foot function, reviewing footwear construction, and then looking at footwear function as an evaluative process.

Patients often ask, what is the best running shoe for me? The answer to that question is as diverse as the patient population. It is important to keep in mind that for every foot there is a shoe. Through the years, we have seen multiple technologies; some stay and some go. We

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He also stated that footwear enhances performance through increasing traction and biomechanical efficiency, and that footwear can also reduce injuries by correcting for the locomotor system static structural misalignments. He goes on to say that footwear protects the foot at the interphase with the ground and the entire body against the forces resulting from repeated foot ground impacts. Running shoe cushioning has proven to be both beneficial and detrimental to runners.

In 1981, Nigg, et al. showed that shoes with more cushioning increased impact forces due to the shoe bottoming out when loaded, and that firmer shoes were more preferential as they did not bottom out. However, in 1987, they also showed that cushioning can reduce impact forces, and the geometry of shoes can affect pronation in rearfoot strikers. Nigg further postulated in the 2001 article in the Clinical Journal of Sports Medicine that the runner reacts to the combined conditions of a shoe sole orthotic or insert cushioning and plantar receptive surface, and accordingly adjusts muscle activity, fatigue, comfort, work, and performance.

Additional research suggests that cushioning in running shoes can cause excessive subtalar joint motion (Clement, et al., 1981). A 1992 article in the American Journal of Sports Medicine by Dressendorfer, et al. showed that reticulocytosis of the rearfoot was increased markedly in runners who ran with a firm shoe versus those with a more cushioned shoe, and that erythropoietic activity was positively correlated with peak G-forces. Finally, Lieberman, et al. in Nature in January 2010 looked at five groups of runners and found that forefront barefoot strikers generated the lowest impact forces versus shod runners and barefoot runners who were rearfoot strikers. However, for rearfoot strikers, running shod produced lower impact forces than running barefoot. So, we are left with conflicting...
research to date as to both the benefits of cushioning and various footstrike patterns and the forces correlated with each.

Foot Function

The next component in evaluating what shoe is best for the patient is looking at the patient’s foot function. Evaluating foot function is certainly a complicated arena to enter. Although we have classically been instructed in the rigid high arch foot, the “normal arch,” and the low arch flexible foot, we all know that there is a greater continuum that exists with some patients having a high arch flexible foot and other patients having a low arched rigid foot. Often, patients are told to evaluate their foot type by using the “wet paper test.” In this test, the patient wets the foot and then stands on a piece of paper and evaluates the foot type that appears. Minimal foot contact is indicative of the high arched foot, moderate foot contact a normal arch, and full contact is indicative of a low arch.

Again, this evaluative process is flawed as it does not allow for patients who fit outside these three classic presentations and does not in any way take into account the rigid flexible foot or the inflexible flatfoot. This is where the expertise of the podiatric physician comes in and our ability to evaluate each foot type. It is important to know the foot type of the patient in order to match it with the best type of shoe for the patient. Classically speaking, the rigid high arched foot is going to go into a cushioned neutral-type shoe, the normal arched patient is going to do best in a stability shoe, and the flexible pes planus foot type is going to do best in a more stable shoe.

Shoe Fit

Fit is also a major consideration. Certain manufacturers make shoes with widths that will better accommodate a wider foot structure; some running and athletic shoes are constructed with deeper and higher toeboxes, which will better accommodate patients with hammertoe deformities. Fit in length is also important. Patients should be fit in shoes to their longest toe, optimally having a thumb’s width in space beyond the end of the longest toe to the tip of the shoe.

Running shoe companies and running magazines use extensive sophisticated testing processes both in the development and then in the evaluation of the performance of their shoes. Classically, flexion tests are done determining the flexibility of the shoe in the forefoot and how smoothly it transitions from heel strike to toe-off. An impact testing is done to evaluate the firmness of the shoes mid-sole. Testing is also performed to evaluate the wear of the shoe and to determine how long it will hold up under use. On the Academy (AAPSM) website, we do an extensive review of shoe construction, describing the outsole upper and mid-sole. The mid-sole lies between the upper and the outsole and is usually composed of EVA or TPU. The mid-sole is the most important part of the shoe in terms of cushioning and stability, and it determines the cushioning and stability characteristics of the shoe, as well as the shoe’s functionality. Manufacturers use their proprietary cushioning systems within the mid-sole foam. Most commonly, encapsulated air gel or other materials are found in shoes such as the Nike Air, Asics Gel, Saucony Grid, Brooks DNA, etc. To date, there has been no research which has shown the superiority of one type of material versus another.

Medial Post

Another important component of the shoe is the medial post. This is the firmer component within the mid-sole and is usually comprised of a dual density EVA and can also contain TPU, which is thermoplastic urethane or carbon fiber. The function of the medial post is to determine the stability of the shoe, and the medial post dampens or decreases the speed of pronation. Medial posts are found in all stability and motion-controlled shoes, but are generally not found in cushioned or neutral shoes. Their benefit is to provide stability, but they do add weight to the shoe. The shank of the shoe stiffens the shoe under the arch area. Most run-
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ning shoes, except the most flexible, incorporate a shank which is usually constructed of urethane.

Shoe Last

The shoe last—the model over which the foot is constructed—describes the shape of the shoe. Last shapes include curved, semi-curved, and straight. Curve-lasted shoes are lighter, more cushioned, and offer minimal resistance to pronation. These are commonly found in racing flats, competition spikes, and cushioned and neutral shoes. On the opposite end of the spectrum are straight-last shoes which, as their name indicates, are straight. They resist pronation to a greater degree, are heavier, bulkier, and generally also incorporate a controlling medial post. Straight-last shoes are found almost exclusively in motion-control shoes. A semi-curved last is a hybrid of the two: less controlling than the straight-lasted, but more controlling than the curve-lasted. This last is typically found in most running shoes.

The last also refers to how the upper is attached to the mid-sole. The construction method utilized here influences the stability, stiffness, and flexibility of the shoe. Most common types are board-lasted, slip-lasted, and combination-lasted, as well as Strobel, which is now the most common type of last construction utilized. In the Strobel-lasted shoe, a thin sheet of material or EVA is glued to the mid-sole, and the upper is stitched to this. It is identified by stitching around the perimeter of the foot bed, and it is a hybrid of the last types (Figure 1).

The significance of shoe construction is that mid-sole cushioning stability devices, the last, and even the fit all add up to determine how much stability the shoe provides. This is essential in our ability to evaluate an athletic shoe and to determine the type of shoe based on the characteristics of its construction. This allows us to evaluate a shoe that the patient presents with, and therefore aid us in determining if that shoe is appropriate for the patient.

Function

The AAPSM fourth evaluated

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step is to look at the function of the footwear. Footwear is classified as maximum stability/motion control, which then can be broken down into maximum, moderate, and minimal; stability; neutral/cushioned; minimalist and barefoot. Each shoe company generates a “footwear comparison” chart for each season in which they list their shoe models versus their competitors’ correspondingly classified shoe models. This footwear comparison chart can be obtained by contacting any of the manufacturers. The AAPSM web site also provides information as to shoe model classification (those listings—for maximum stability/motion control shoes, stability shoes, and neutral cushion shoes—are listed here in Table One). The most popular shoes are stability shoes. Characteristics of the maximum stability/motion control shoe are the largest, densest medial post, straightest last, and maximum pronation resistance—and they are heavier and stiffer. Stability shoes are a hybrid containing semi-curved lasts; some have medial posts and shanks. Neutral/cushioned shoes have no medial post, are curve-last, have minimal pronation resistance, and are light and flexible.

An interesting phenomenon in shoe design is that manufacturers are moving on the one hand towards more high-tech, more biomechanical correction in the shoe with semi-customization and computer feedback, but the major trend that we see today is towards barefoot and minimalist running. In the category of semi-customization is the Somnio running shoe. Somnios were tested at the Boulder Center of Sports Medicine and contain various design components that allow semi-customization in biomechanical correction. A shoe retailer must be qualified in order to utilize the technology necessary to evaluate a runner for Somnios.

Markers are placed upon the runner’s feet, legs, and hips. The runner utilizes a treadmill, and a computer evaluates various angles to determine how much biomechanical correction this runner needs. The technician then utilizes this information to choose from three full-foot varus wedges that are available, each with a different amount of correction built in, three foot beds each with different arch heights, and cushioning inserts at the first MTPJ and the heel. Somnio attempts to customize shoes based on the functional needs of the indi-
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Unstable Shoes
The unstable shoe category, made popular by MBT shoes, Reebok, and Skechers, is another trend in athletic shoes. This technology was developed based on the Masai, an African tribe, and how they walk in the sand. These unstable shoes are also termed toning shoes. The theory behind them is that they turn our flat hard artificial surface into a natural uneven ground, similar to walking in sand. Due to this change in function, these shoes challenge the core strengthening muscles to be more active. This changed muscle action then creates good posture, and increases shock absorption for the joints, while significantly reducing musculoskeletal compression. This technology appears to be very similar to the rockerbottom technology used by pedorthists and podiatrists, but a cause of athletic injury. McDougall bases this conclusion on his observations of the Tarahumara, a tribe noted for their ability to run extreme distances in difficult environmental conditions with relatively little injury. Born to Run has created a devoted group of runners who have adopted this barefoot running trend, either incorporating it as part of their routine, or moving to training entirely this way. The book is a vivid tale, but does take dramatic literary license in its interpretation of the events that are portrayed. It has been, however, a best selling book and has generated an entire technology behind it.

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Research suggests that cushioning in running shoes can cause excessive subtalar joint motion.

Figure 5: Nike Free

Born to Run by Christopher McDougall suggests that running long distances barefoot is the key to happiness and longevity. McDougall proposes that the elaborate architecture and cushioning of shoes is mentally friendly. Brooks has developed the Mogo mid-sole. Traditional mid-soles can last up to 1,000 years in landfill. This new material will change that 1,000 years to 20 years, therefore making it more environmentally friendly.

Another shoe technology that has gained popularity is the Newton shoe. The Newton shoe was designed specifically for mid- to forefoot strikers and actually contains what are termed actuator lugs, which are raised rubber rectangles located in the forefoot of the shoe. At contact, the lugs are pushed into the mid-sole, where they stretch a membrane. At push-off, the membrane rebounds and the actuators are pushed from the mid-sole back to the outsole, returning energy into the forward propulsion (Figure 3). Another shoe built along this similar philosophy is the Karhu, which encourages minimal heel contact time and embraces a fulcrum technology to return energy to the runner.

The pose running method developed by Nicholas Romanov, a Russian Ph.D., has been advocated by its proponents to decrease injury rates in runners. This is a movement method based on maintaining a particular strike and body position where the runner lands on the ball of the foot, keeps the foot in an initial position and does not push off, but rather pulls the foot off the ground using the hamstring and allowing gravity to be the primary force in moving the body forward. Romanov postulates that it is the heel strike, present in most runners, which is the cause of most running injuries, and proposes his alternative method as a solution to these injuries. The use of the Newton and Karhu shoe fits into this philosophy. Again, research is conflicting in this matter. Multiple studies have shown no metabolic or functional advantages for a runner who attempts to switch foot strike pattern. Gruber, et al. in 2009 in ACSM noted no difference in oxygen cost.

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adapted from tire technology. This allows the entire shoe to roll up upon itself, so that there is very little support that comes from the shoe. The shoe has what Nike terms a better anatomical shape design and is extremely lightweight as the midsole and the outsole are the same material, a phylon rubber blend. In addition to the Free, Nike has developed the Glide, in which it incorporates 2 degrees of varus correction in the shoe (Figure 5).

Ecco has also come out with the Biom, which is more shoe than the Nike Free, but still attempts to adhere to this barefoot philosophy. The shoe most similar to actually being barefoot is the Vibram 5 Fingers shoe, basically a rubber protective covering with individual toe structure. This seems similar in many ways to an Aqua shoe in terms of the protective nature that it provides to the foot. The more hardcore barefoot running proponents tend to utilize this running shoe as it does most closely mimic the barefoot condition while providing a protective covering for the foot.

Summary

In summary, advising patients as to shoe choices is an art. Technology is constantly evolving, constantly improving, and constantly changing. Frequent research debates each new technique and technology. Running shoe companies are constantly seeking new and better ways to address the needs of the runner, whether that be for greater injury protection, lighter, more comfortable shoes, or new trends that appear. It is a combination of all these approaches and philosophies that can help guide us as to what is best for our athletic patients. The importance of thoroughly evaluating the patient’s anatomy, function, and injury history cannot be overstated. Knowledge and staying abreast of current shoes and current technology is essential for the sports medicine podiatrist. Even if one does not have an extensive sports medicine practice, one will not be able to get through a day at the office without encountering some or all of these shoe issues.

For patients who wish to incorporate unstable shoes or barefoot running into their workout schedule, it is best to always approach this as one would approach a new training activity or training regimen, with the gradual introduction of the new entity and constant monitoring should any problems arise. This will allow the patient to best adapt to new techniques and to identify any problems that may occur.

The American Academy of Podiatric Sports Medicine website and running shoe page can also help one in day-to-day practice by providing the most current up-to-date information on shoe technology and shoe models. Armed with this knowledge, we are best able to help our patients make their healthiest choices.

Bibliography


Nigg, B.M. and Morlock, M. The influence of lateral heel flare of running shoes on pronation and impact forces.