# Key Insights On Recommending Running Shoes

Believe it or not, the running shoe first originated as a leather upper with a leather sole. Adidas running shoes date back to the late 1800s but many of the technical advancements did not begin to appear until the 1970s. In 1971, Bill Bowerman and Phil Knight created a shoe manufacturing company called Blue Ribbon Sports (BRS), which eventually became Nike, Inc. While he was coaching track and field at the University of Oregon, Bowerman created the first cushioned midsole by heating polyurethane on his wife's waffle iron in his garage. What followed was an enormous amount of research and development that led to the creation of Nike Air and many more technical components that are incorporated into today's running shoes. As the manufacturers have improved shoes, they discovered a greater understanding of biomechanical deficiencies, such as excessive pronation, that are inherent in the foot. By the early 1980s, manufacturers were modifying the midsole portion of shoes to control abnormal pronation. Today, there are many adjunctive components of shoes that help improve function for most runners with pronated foot types. In my experience, many people discovered through trial and error that the type of shoe they used created major exercise-related injuries (shin splints, stress fractures, etc.). We found that most people were wearing the wrong style of shoe for their foot and running style. For example, a runner with a stable foot type maintained a 40 miles-per-week schedule. He bought shoes he read about in a running shoe magazine without researching the features. The shoe was made for a pronated foot type. The athlete didn't have this foot type and subsequently had significant pain within four weeks of using the shoe. Given the technical aspects of shoe construction today, it is easy for a runner to end up in a shoe that can cause harm.

**A Review Of Running Shoe Lasts**

When it comes to running shoe construction, all shoes are constructed from a last. Generally, running shoes have a straight last, modified last or a curve last.
Straight lasted shoes have more material maintaining support beneath the medial column of the foot. These shoes are recommended for the severe, overpronated foot type.
Modified last shoes are built with a shape that is neither straight nor curved but in between the two shapes. This last is the most common type of shape one will see with running shoes. These type of shoes may or may not have adjunctive components built into the midsole for motion control.

One would primarily reserve curved lasted shoes for racing flat shoes as they provide an optimal level of lightweight material but lack stability. The rare foot type that underpronates would benefit from a curved lasted shoe, provided the shoe has the desired level of cushioning.

**Understanding The Key Components Of Running Shoes**
The three main components of a running shoe are the upper, the midsole and the outer sole. The upper materials are mostly comprised of lightweight synthetic materials with a focus on breathability. While the structure of the upper may vary from shoe to shoe, there is very little difference among different brands with the exception of off-road or "trail" shoes, which have more durable, reinforced upper material.

The outer sole of a running shoe is the rubber tread component of the bottom of the shoe. Materials vary from high-grade carbon rubber (similar to car tire materials) for maximum durability to a combination of high carbon rubber at the rear of the shoe and a lighter weight rubber under the forefoot to reduce weight and add a softer feel. The running surface has an impact upon the type of outer sole that is preferred for the shoe. The runner who primarily runs on concrete or asphalt may benefit from the durability of the high carbon outer sole. The more elite level of runner who maintains a faster pace and seeks better performance may opt for the softer blown (or low-density) rubber outsole for lighter weight.

The midsole of a shoe is the portion between the outsole and the upper of the shoe. Since the early 1980s, this midsole is the portion of the shoe that has undergone the most modifications and improvements by all the shoe companies. The material of the midsole traditionally consists of either ethylene vinyl acetate (EVA) or polyurethane foam. EVA has the advantage of being lightweight, soft and flexible, and one can meld this material to different densities within the same midsole. However, one must remember that EVA is not as stable or as durable as polyurethane. In addition to the increased durability and stability, polyurethane provides excellent impact protection but it is firmer, heavier and stiffer. The midsole is also the section of the shoe where manufacturers add adjunctive components to differentiate the type of stability the shoe will provide.

Adjunctive midsole components are devices that control abnormal levels of pronation within the shoe. The amount of support varies depending on the shape of the last in which the particular shoe is built. Typically, one would find these devices in the medial aspect of the rearfoot. These midsole components help slow the rate of abnormal pronation from heel strike through the midstance of gait while the person is running.
Materials used within the midsole to control pronation vary from a more dense portion of foam, usually indicated by a darker color, to Kevlar or other plastic components. Nike has recently developed a multi-compartment air bag midsole with the medial compartments having higher pressure to control pronation. The level of support varies from company to company and shoe to shoe but all brands have multiple models that provide support for varying degrees of pronation.

**Why It Is Critical To Evaluate Gait And The Runner's Old Shoes**
Evaluating the gait of the runner is relatively simple for the foot and ankle physician but physicians do not sell running shoes. My suggestion to patients in my area is to locate a reputable running shoe store. Such a store will have reliable personnel who have the experience and training to identify typical foot problems by evaluating the wear patterns

of old shoes.
When I evaluate the gait of these patients in my office, I also look at and evaluate the shoes because the patient's running gait pattern may differ somewhat from his or her walking gait pattern. For instance, a patient may have mild pronation while walking in the office but may run and train at a six-minute per mile pace. The patient's running pace affords little time to evaluate the stance phase of the gait cycle. Accordingly, the pronation the patient exhibits when walking may not be appreciable while he or she is running.

The second part of the patient evaluation is evaluating his or her old pair of shoes critically. The wear pattern of the bottom of the outsole is not critical when determining whether the patient needs motion control. Evaluating the midsole and the foot cup in the rear of the upper is more critical when examining a shoe. I recommend evaluating the midsole for evidence of compression along the medial versus the lateral portion of the posterior aspect of the shoe. The medial portion of the midsole beneath the rearfoot may show more evidence of pronation, which may help indicate the need for a more stable shoe. Observing the shoe from the posterior aspect and bisecting the heel cup may also show evidence of an inward deformation, which would also support the need of greater stability.

The third part of the patient evaluation is simply ascertaining the relationship of the individual's height and weight to the speed he or she maintains while running. For example, one might clinically evaluate two runners who both display excessive pronation during gait. The first runner, a 220-lb. patient, who runs at a nine minute per mile pace, will spend more time with each step in the stance phase of the gait cycle than the second runner, a 150-lb. patient, who trains at a six minute per mile pace.
The heavier runner will require more stability in the shoe compared to the lighter runner. This is not due to a more unstable foot but rather the fact that the heavier runner runs slower and allows more time for his or her feet to pronate through heel strike and midstance, which is accentuated by his or her weight. The lighter runner who runs faster will not require as much stability due to the foot speed, resulting in less time for the foot to pronate through the contact and midstance phase of gait.

**A Guide To Leading Running Shoes**
In my office, I evaluate the patient's foot and shoes, and list a few types of shoes he or she may investigate. However, it is important to have a fundamental grasp of running shoes before recommending these shoes to the patient.
Motion control shoes are footwear for runners who abnormally or excessively pronate through the stance phase of gait. The level of control can vary greatly from one model of shoes to the other. With this in mind, here is a breakdown of some technical information for the most supportive motion control shoes, moderate motion control shoes as well as neutral stability shoes for runners.

Due to the vast number of running shoes available, I chose models based on performance and reliability. Shoe companies that produce running shoes include Adidas, Avia, Asics,

Brooks, Mizuno, Puma, Pearl Izumi, New Balance, Nike, Saucony, Reebok and others that provide over 600 different styles of shoes.

**When The Runner Needs Strong Motion Control**

The shoes that feature strong motion control each have straight last construction.
Beast (Brooks). This shoe features an EVA dual density midsole with thermoplastic medial reinforcement for pronation control. The Hydro-Flo pads in the rearfoot and forefoot improve cushioning and durability. The removable insole allows concomitant use with orthotics. It also features a strong internal plastic heel cup.

1122 (New Balance). This model has a dual-density, polyurethane midsole with a graphite insert in the medial heel for optimal control of overpronation. Its forefoot EVA foam increases flexibility and comfort, and reduces weight. The removable liner permits concomitant use of **Orthotics**. It is available in widths from B to 4E.

Renegade (Mizuno). The Mizuno Renegade comes with a Pbax plastic wave plate with a medial wedge imbedded in EVA foam. Its design helps to decrease the rate of pronation from heel strike through midstance. It is a lighter and softer shoe with outstanding pronation control.

**Assessing Shoes With Moderate Motion Control**

These shoes, featuring moderate motion control, all have modified last construction as well as a removable liner for easy use of orthotics.
Air Structure Triax (Nike). This shoe has a dual density EVA midsole with a thermoplastic foot bridge through the posterior medial heel for very good motion control. It features an air bag imbedded in the rearfoot and midfoot for outstanding cushioning and stability.

Omni (Saucony). The Omni also has a midsole made of dual density EVA. Its Kevlar GRID technology enhances motion control and cushioning. It is a unique shoe that is lightweight and flexible but stable.
Supernova (Adidas). The dual density EVA midsole has a thermoplastic insert for excellent motion control. Its torsion Kevlar bridge provides torsional stability between the rearfoot and forefoot.

**What You Should Know About Neutral Stability Running Shoes**

The following neutral stability shoes feature modified last construction.
Air Pegasus (Nike). This model has polyurethane rearfoot foam with air bag technology for excellent cushioning, stability and durability. The EVA forefoot, which also offers air bag technology, offers lightweight materials, durability and impact protection. The shoe

is a time-tested model that has been available for over 20 years.

Landreth (Asics). Its full length EVA midsole with gel inserts provides outstanding cushioning and durability. It is an excellent combination of good neutral support, cushioning, flexibility and durability.

2060 (Avia). In addition to having an EVA midsole, the shoe has blended foam inserts for increased durability. Its unique cantilever rearfoot design creates superior motion control both medially and laterally. The shoe is excellent for off-road or uneven surfaces.

In Summary

The technological advancements we have seen with running shoes over the past 20 years is staggering. Hundreds of models of shoes are available, and many of these address specific needs depending on foot type. Purchasing a shoe with features inconsistent with the needs of the runner can result in injury. Having a basic knowledge of the types of shoes available for the runner can prevent potential discomfort, frustration and even injury to your patient.

There are many factors to consider when purchasing or recommending a running shoe. General information should include the weight of the runners, the pace at which they run, the surface on which they run, the frequency of runs and any running related injuries they have had in the past.

It is important to perform an appropriate gait evaluation and ensure an adequate evaluation of the patients' old running shoes. Also keep in mind that one usually observes gait in the office with the patient walking and this may be vastly different from his or her running gait. I rely heavily on the evaluation of the old running shoes as worn shoes will reveal what a patient's foot is doing specifically when he or she is running.

When treating runners, I also recommend that they shop for their shoes in the evening. They should also try on several different styles of shoes and run in these shoes if permitted to do so by the establishment. The bottom line is purchasing the shoe with the appropriate features that fit properly. Runners can try on several different shoes with the exact features they need but every model will feel different and will affect performance if the shoe does not fit properly.

# COACHES CORNER

## My runners shoes wear differently. What can you tell about the individual's biomechanics from the wear pattern?


**Q:** I am a high school cross country and track coach. Are there any tips you can give me about shoe wear patterns which can help me evaluate my athletes' running mechanics?

**A:** The ability to examine shoe wear can be most helpful in evaluating that athlete's biomechanics and what shoes may work the best for them. If an athlete suffers repeated injuries, shoe wear patterns may provide some clues as to why that athlete is injured. There are some simple things to evaluate. Keep in mind- one pair of shoes may wear differently than another, so it is important to check several pairs of shoes, including street shoes. In evaluating wear patterns look at:

1) Symmetry, is the wear equal and in the same place on both shoes? If one wears harder than the other or more centrally on the back of the heel, that may indicate a leg length discrepancy or over striding on one leg;

2) If you put the shoes up on a table and look at them from the back, is the bisection of the heel counter perpendicular to the table or are the shoes tipping in (as in pronation) or

to the outside (supination)? Or does one shoe tip in and the other out? That can again be indicative of a leg length discrepancy. If the shoes show pronation, as is common in the flat foot type, then the runner may need more control of the pronation to avoid overuse injuries. If the shoes show supination, then this runner may need less control and more shock absorption. The typical injuries of someone who supinates, the high arch foot, are injuries of poor shock absorption;

3) Look at where the toe box bends or if the toes are "popping up" into the leather/mesh uppers. Some shoe manufacturers extend the lacing too far forward on the tops of the toes. This can restrict the fluid movement of the toes in running and lead to problems like shin splints. Also look if the creases in the toe box are straight across the toe box or oblique. If the creases are sideways, that can be indicative of poor fit, stiffness, or again the lacing system being too far forward. Finally in fitting the shoes, try them on later in the day to provide for swelling, have at least 1/4" to 1/2" clearance from the end of the longest toe to the end of the shoe, measure the foot, and be sure the shoe is comfortable in the store.

Becoming familiar with some of the nuances of shoe wear patterns, is one of the most fundamental and useful tools at your disposal to help your athletes have fewer injuries.

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