

What's New in Running Shoe Technology?

Computers, hi-tech materials, and design changes have led to improved footwear.

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The average podiatric physician prescribes athletic footwear as often as 50 times per week. A previous survey of members of the American Academy of Podiatric Sports Medicine has indicated that the majority of prescriptions for footwear are in the running shoe category. At the same time, the running shoe category can be the most challenging to understand and remain current in terms of keeping up with new technologies.

Most athletic shoe companies showcase their new technologies and marketing gimmicks in their running shoes. Then, if the technology is successful, it will appear in other categories such as basketball and tennis. The introduction of the Nike Shox followed this same pattern when it was launched in running shoes several years ago.

Currently there are several new technologies incorporated in running shoes which may sound gimmicky, yet may have benefit for the patient. Often, it is difficult for the podiatric physician to separate fact from fiction when reviewing marketing brochures from athletic footwear companies. Too often, patients ask us what we think about a new shoe being advertised in the media, and we really know nothing about the technology. Worse, when we investigate the advertising claims, we commonly find that there is little scientific evidence or research proving that the technology really works.

This article will review three new technologies currently found in the running shoe market. An effort will be made to separate fact from fiction and guidelines will be offered for application of these technologies to your patients.

Adidas 1

The Adidas 1 is probably the most fascinating of new running shoe technologies. Introduced in Spring, 2005, this shoe created quite a buzz in the media after it was billed as the first "intelligent" sport shoe. Why? It contains an on board computer!

As Adidas states, "Put on a pair of Adidas 1 and just four steps from your door, these shoes have already analyzed your speed, weight and the terrain underfoot and have determined the perfect level of cushioning for your needs."

How does the Adidas 1 work? A magnetic sensor, located in the arch section of the midsole of the shoe, monitors changes in weight, pace and surface type 1,000 times per second and sends the information to the computer "brain" also located inside the midsole of the shoe. This "brain" is actually a microprocessor capable of performing five million calculations per second. The microprocessor uses the information from the sensor and performs calculations to determine if the shoe's cushions are in the "ideal" zone.

Cushioning is adjusted via a motor-driven cable system which connects to a cushioning cylinder located in the heel portion of the shoe. If the cushioning is too soft, the cable tightens the cylinder. If the impact has been determined to be too firm, the cable relaxes the cylinder so that a "perfect level of cushioning" is provided at all times.

The shoe retails for \$250 and includes lithium batteries which must be replaced every 100 hours.

Proposed Benefits

Among the many claims made by Adidas concerning the "1" are: A shoe which continuously adapts to the demands of the individual runner... Provides the "perfect level of comfort and performance at all times"... "Ensures a running experience uniquely tailored to your pace and the ground conditions at hand."

The Reality

The world's first "intelligent" shoe may be one of the best marketing gimmicks in the footwear industry in recent years. Almost all of the premium running shoes stores in the United States sold out their initial supply of Adidas 1 in just a few weeks after release this spring. It seems there are plenty of consumers who either believe this technology really works or simply want to be the first in their neighborhood to show off a \$250 pair of running shoes.

Wear testers have noted that the Adidas 1 really does change cushion depending on terrain and running pace. The change can definitely be perceived by the user. Also, you can manually adjust the cushioning setting of the shoe, and the extremes of soft vs. hard settings can be easily perceived when running. So, the mechanism inside the shoe to adjust the cushion appears to really work.

The real question is, What is the ideal level of cushion? How would this ideal level vary depending on terrain and running pace?

To date, there ARE no reliable scientific data showing the ideal safe range of cushion required in athletic footwear to protect from injury, enhance performance, or reduce muscular fatigue(1). Studies of cushioning of shoes and inserts on running athletes have led to confusing outcomes in terms of injury prevention (2,3).

For example, a neoprene insole has been shown to reduce the incidence of overuse and tibial stress injuries in military recruits. Impact-related injuries during military training were also reduced by using a modified basketball shoe compared to a standard infantry boot. The overall incidence of overuse injuries, however, was not reduced with the cushioned shoe. Clearly certain impact-related injuries have been shown to be reduced by cushioned footwear, while most overuse injuries are unaffected. The benefit of cushioning applied to the foot in reducing injury is thus still not recognized.

A shoe which constantly monitors impact and adjusts the midsole cushion accordingly sounds tempting to the serious runner. The real question is, "What is the ideal cushioning for each individual runner?" Adidas provides no information about how this "ideal" setting is calculated, and what scientific information is available to validate how this figure is determined.

In the end, if Adidas has uncovered a secret formula for ideal cushion and injury prevention, then their technology will pre-empt the footwear industry. If they haven't, Adidas can pat themselves on the back for at least creating a marketing phenomenon and selling the highest-price running shoe in history.

Nike Free

If cushioning really isn't important, then runners should love the new Nike Free. Introduced last year, the Nike Free 5.0 running shoe is designed to provide the benefits of barefoot running, with the minimal protection against abrasion that a shoe can provide. Benefits of barefoot running? More on that in a moment. First a description of the shoe:

The Nike Free 5.0 and now the Nike Free Trainer are designed to provide the most flexible, lightweight shoe possible. The upper material is extremely elastic and forgiving, allowing the "shoe to fit the foot." There is no heel

counter - only soft upper material. The sole of the shoe is constructed of Phylite foam ,which is extremely light. For abrasion resistance, the foam is covered on the heel outsole surface with BRS 1000 rubber inserts.

The barefoot benefit of this shoe is provided by numerous flex grooves which cut through the midsole, dividing it up into little squares or boxes, less than one inch in size. The grooves run longitudinally and medial-laterally. Thus, the Nike Free bends freely in all cardinal body planes and in all areas of the foot. This shoe will not restrict or inhibit any foot motion except forward-aft and medio-lateral shear.

Proposed Benefits of Barefoot Running

While many podiatric physicians would shudder at the thought of having their patients run barefoot, this practice is actually widely accepted among respected coaches in the track and field community. For years, legendary coaches such as Brutus Hamilton, Brooks Johnson, and Vin Lananna have utilized barefoot running as part of an overall training regimen to produce world class runners in many distances. Percy Cerutty coached Herb Elliot, one of the greatest 1500 meter runners of all time, using barefoot workouts on grass up to three times per week.

Brooks Johnson, a legendary Olympic sprint coach has long advocated strengthening of the intrinsic muscles of the feet to improve running performance. Vin Lananna coached many NCAA champion athletes at Stanford University where barefoot workouts on grass were common practice. In fact, the notion of the Nike Free shoe was developed by Nike designers Toby Hatfield and Eric Avar, who were watching a Stanford track workout.

The barefoot state is thought to allow better neurostimulation of the tactile sensors located on the foot, resulting in greater muscle stimulation. With repeated barefoot workouts, the foot and leg are thought to be strengthened and performance will improve. There are numerous inferences in the marketing pieces on the Nike Free that barefoot running will prevent injury.

Nike has performed their own in-house research and claims that a prospective study showed that runners training in the Nike Free significantly improved performance after a 6 month period. Other research in Canada this past decade has suggested that running shoes may compromise proprioception and muscular activation of the leg in running athletes (4-6).

The Reality

Nike's website boasts of their world class runners, such as Paula Radcliffe and Suzy Favor Hamilton, who now wear the Nike Free and also do barefoot training in their workouts. This may be true, but how many athletes of this caliber do you see in your practice?

Most important, all advocates of barefoot running have utilized this technique as a smaller portion of an overall running program where shoes were worn. Nike makes this very clear with a training manual provided with each pair of Nike Free shoes, emphasizing the need for gradual adaptation to the technology.

Therefore, the Nike Free should be thought of as a training tool designed to improve running performance in athletes who are competing at a very high level. Even in these situations, the shoe is not recommended for day-to-day running, only intermittently as part of an overall training program.

Of concern is the recent availability and promotion of the Nike Free in major department stores. Now, the non-athletic shopper will be attracted to this lightweight sleek shoe and assume that it can be used for casual walking and everyday use. Potentially, a surge in plantar fasciitis and Achilles tendinopathy may result as this shoe is used for the wrong purpose, by the wrong type of user.

ASICS

ASICS has taken a more rational approach to research suggesting the ill-effects of running shoes. ASICS is also one of the few athletic shoe companies who have hired and listened to a podiatric physician in developing new technologies. Dr. Simon Bartold, a respected sports podiatrist in Australia, has been heavily involved with ASICS over the past seven years, evaluating and performing research on the effects of footwear on running athletes. Bartold has basically taken the body of research published in the literature and at ASICS, and concluded that current "motion control" running shoes may not be so great after all.

Recognizing that there is a huge market for shoes designed for the over-pronator, ASICS has set out to design shoes for these foot types which allow the foot to function more efficiently. Dr. Bartold points out that design of current "motion-control" running shoes is counterproductive: the inflexible and heavy midsole inhibits proprioception and inhibits the windlass mechanism of the human foot.

Thus, ASICS has designed two "maximum support" shoes, the Gel-Foundation VI and the Gel-Evolution, which allow more contact phase pronation and enhanced proprioception. This is accomplished with a cushioned, lightweight flexible shoe which feels much like a cushioned trainer, rather than a motion-control-type shoe which is designed for the over-pronator.

Both the Gel-Foundation and the Gel-Evolution contain a myriad of component parts designed to "guide" rather than "block" foot motion. From the Dynamic Guidance Cradle, to the Duo Truss System and the "twist" Gel Cushioning System in the forefoot, the Gel-Evolution is purported to be the future for unstable runners.

Proposed Benefits

ASICS has modified the concept of motion control for over-pronators and instead has proposed that pronation is a natural motion which should be "guided" rather than "blocked." The benefit would be increased comfort and more natural foot function for the user.

The Reality

The cornerstone of the Asics technology is to enhance comfort of the foot by providing lightweight, flexible footwear which is well cushioned. This may not translate into support or motion-control for the average podiatric physician.

Newer exciting research performed by Anne Mundermann and colleagues at the University of Calgary, however, has shed light on the relationship between comfort and improved biomechanical function of the lower extremities(7,8). Although these studies were performed on shoe inserts and foot orthotics, the findings should be applicable to footwear. In essence, this research has shown that when comfort underfoot is improved, so is muscle function and kinematic function of the lower extremities.

While we might think that our orthotic technology works by limiting joint motion, the research shows that the effects of orthotics are on forces and muscle function. Thus, limiting joint motion may not be possible with orthotics and running shoes.

ASICS has taken the plunge by providing light flexible shoes designed for the overpronator. Certainly, your patients would probably prefer these shoes over heavier motion-control shoes when trying them on in the store. The jury is out on whether these newer lightweight shoes will reduce injury in the overpronator.

ASICS has dropped two shoes which were well-received by the podiatric community for control of the over-pronator: the Koji and the MC +. Both were

typical of the stiffer, "brick" style motion control shoes which most podiatric physicians would prefer for heavy runners or severe pronators.

If anything, ASICS should be commended as being the strongest supporter of the podiatric profession of any athletic shoe company over the past ten years. They have been premier sponsors of the APMA and have also supported the American Academy of Podiatric Sports Medicine for many years. Few, if any, other athletic shoe companies have consistently supported our profession over the past decade, even though we recommend footwear on a daily basis.

Conclusion

The recent trends in running shoe technology has potential direct repercussions on the way podiatric physicians treat the foot with custom orthoses. Certainly, much of the research validating new construction techniques for running shoes was actually the result of studies of foot orthoses and runners.

Perhaps in the future we will see computer-assisted cushioning systems added to custom foot orthoses. Maybe we will look for ways to increase proprioception with orthoses in hopes of improving muscular activation of the lower extremities.

In the meantime, most podiatric physicians will gain confidence in these new innovations when meaningful research and positive clinical experience verify that these technological breakthroughs really work.

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