

FOOTWEAR TECHNOLOGY

Biomechanical studies carried out at the German Sport University in Cologne into the use of cushioning in sports shoes have revealed surprising results.

Questions over cushioning

Professor Peter Brüggemann of the German Sport University in Cologne has never been afraid of challenging common perceptions. He is the expert who, at the start of 2008, carried out independent studies on the Cheetah Flex-Foot prosthetics that double transtibial amputee athlete Oscar Pistorius uses, concluding that the South African can achieve the same speed as other sprinters using the technology, but expend 25% less energy.

It was this conclusion that led to the decision from the International Association of Athletics Federations that Pistorius would not be allowed to compete in its competitions, sparking an outcry from people all over the world who were, naturally, sympathetic to the athlete's plight. Pistorius himself lodged an appeal with the Court of Arbitration for Sport in Lausanne, which he won; he would have been eligible to compete at the Beijing Olympics but was not selected by the South African team. He competed at the Paralympic Games instead and won gold medals in the 100m, 200m and 400m events.

Professor Brüggemann, whose role was to put emotion to one side and look purely at the science involved in using the prosthetics—a carbon fibre product made by Icelandic company Ossur—quickly turned his attention to other matters, such as examining the effects on the human foot of cushioning systems in athletic shoes. Revealing his findings at the International Union of Shoe Industry Technicians (UITIC) congress in Elche, Spain, towards the end of last year, he once again challenged two commonly held concepts: that cushioning enhances performance and helps prevent injury.

"If you ask runners what matters most to them, they say comfort, and, within that, fit is the number-one factor," he explained. "And when you start to examine the implications of this, you can see a difference in an athlete's oxygen intake depending on how comfortable their shoes are. The more oxygen you take in, the less energy you consume, so energy consumption is linked to comfort."



South African athlete Oscar Pistorius.

Ossur

This means that a shoe that fits well will aid performance much more than an ill-fitting shoe with lots of cushioning incorporated into it. Comfort, according to this research, depends far less than we might have imagined on reducing the amount of impact a foot, an ankle and a knee have to withstand as a runner moves along. "At first, specifically for running shoes, the midsole was given over to cushioning devices," the professor continued. "But shoes became unstable, so manufacturers started adding control devices. Nevertheless, the biological system of a runner is much more sophisticated than that."

Part of university's study on this subject involved 130 runners, who took part in different events on a variety of terrains that meant low, medium and high rates of impact. Professor Brüggemann and his team recorded details of all

Fit is the principal factor if running shoes are to enhance an athlete's performance and help prevent injury. Cushioning can have the opposite effect.

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Professor Peter Brüggemann of the German Sport University in Cologne believes cushioning in running shoes is a failed concept.

 German Sport University Cologne

the injuries these athletes suffered over the course of a season. Bearing in mind the varying levels of impact, he said the result of the study, outlining which runners had the highest frequency of injuries and which the lowest, plus details of the kinds of injury they suffered, was "completely unexpected". It turned out that athletes who subject their bones and joints to high impact were more injury-free than those who took a softer option.

The professor concluded: "Impact leads to an increase of the bone mass. This means that the whole concept of cushioning is failed."

Cushioning affects pronation, the way the foot rotates when we leave a standing position, which can leave the ankle joint and the medial side of the knee susceptible to higher force and, in excessive cases, even lead to a valgus deformity. Joints and Achilles tendons can become decoupled. Even if there is only a small possibility of an athlete's condition or running style leading to injury, excessive pronation can increase the chances substantially. You can feel it, Professor Brüggemann insists: cushioned shoes can cause internal tibia rotation, which affects the mechanics of the knee and other joints.

"So is it the case that high levels of pronation must lead to injury? We can't say that," he continued. "It's not necessarily the case. But the locomotor system does not react systematically to interventions with shoes. If a shoe increases foot pronation, it decreases locomotor control. If the foot is unshod, it behaves in a different way compared to a foot with a shoe on. The initial

plantar flexion is different. You can also affect the muscles that counteract pronation."

For all these reasons, motion control concepts really should "consider the sagittal plane", the body's natural way of holding itself and of moving, and not rely entirely on mechanical support. He said footwear manufacturers should concentrate their efforts to enhance performance by improving fit and finding ways to minimise energy loss. On the subject of protection, he argued that it was a mistake to engineer in devices that stop athletes from using their joints and muscles in the way that nature intended; a good shoe should help them use those parts of their anatomy better so that, in training, athletes can use their shoes as a work-out tool. He offered the Flexor hallucis longus muscle as an example. "Load that muscle [the largest and most powerful of the deep muscles in the posterior compartment of the leg], and it will become more developed, more powerful," Professor Brüggemann explained. "A flexible shoe can help you do that."

None of this means shoes should lack comfort, but he made the point again that the number-one factor that athletes have offered to him in terms of comfort is fit. If a shoe fits well, it will help runners lower their energy consumption. "I have only been able to give a rough overview," he said at the end, "but I think there is a radical footwear discussion to be had on this subject from a more scientific point of view." 



If their shoes fit well, athletes will consume less energy.

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