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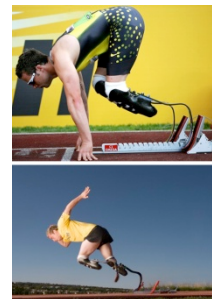
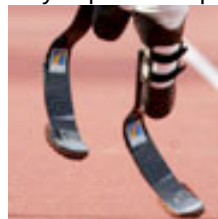
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Prosthetics for High-Performance Amputee Runners: The Cheetah Flex-

It's amazing to think that just a few years ago a person without legs would be able to compete as a runner at the Olympic level. Prosthetics technology has advanced at such an extraordinary rate though, that for a period of time, runners with prosthetic limbs were banned from Olympic competition for fear that they had an unfair advantage over able-bodied athletes. Double-amputee Oscar Pistorius, along with many other disabled athletes, challenged the idea of his having an advantage due to the use of his prosthetic legs. Pistorius finally won the right to compete in the 2008 Beijing Olympics, pending that he qualified. Although he didn't, he did help pioneer a milestone movement in professional athletics. Pistorius's controversial case dealt with his superiorly functioning "Cheetah Flex-Foot" prosthetics. Inspired by the shape of a cheetah's rear legs, the Cheetah Flex-Foot [Cheetah] has become a favorite prosthetic device for not only Pistorius, but a vast amount of professional amputee athletes

The Cheetah is a custom made prosthetic sprinting foot for track and field sports. It was created by Van Phillips, an amputee himself, after having dealt with many subpar prosthetics. The Cheetah allows for the athlete to have a more natural stride while maximizing comfort during intense activity, specifically sprinting. The Cheetah Flex-Foot is made of 100% carbon fiber—a very strong and flexible material used a great deal in the aerospace industry. Carbon fiber is fabricated by "lining up thousands of thin carbon filaments, and subjecting them to extreme heat, which forms strong interlocking bonds between the chains of carbon atoms" (Hamilton). The Cheetah was engineered by Hilary Pouchak and is now manufactured by Ossur North America at a cost of about \$22,500. Ossur has also developed the "Flex-Run™" and "Flex-Sprint™ (Flex-Sprint™ I)" which are versions of the Cheetah that are meant for use by individuals performing less intense activities. The company is currently working extensively in the field of Bionic Technology, too.

The controversy over the Cheetah Flex-Foot is due to the prosthetic's seemingly extreme efficiency. In comparison to other prosthetics, the Cheetah is unmatched. The "C" or "J" shape of the Cheetah is what allows for the carbon fiber's properties to be taken full advantage of. However, when compared to a human foot, it is lacking key factors that would make it advantageous to an athlete. Experiments done on the Cheetah produced results that showed that sprinting

requires 25% less energy with prosthetics than with natural legs. While this may be true, a study published in *Archives of Physical Medical Rehabilitation* found that a human foot during a running stride will give back a 241% energy return while the Flex-Foot only had an 82% spring efficiency. This difference is because of the contraction of the calf muscles in a human leg versus a prosthetic socket's inability to perform that task. Also, when it comes to racing, the lack of ankles in the design of the Cheetah is cause for a slower start as well as difficulties in maneuvering a curved track. The slower start is countered by the shape, however. After the runner pushes off, the Cheetah returns to its original shape which propels the athlete forward. Because the Cheetah is a passive foot, it is limited to only storing as much energy as during the loading phase of running. Therefore, based upon the biomechanical factors alone, it is not possible for an amputee using the Cheetah Flex-Foot to have an advantage over an able-bodied athlete. The Cheetah Flex-Foot was first marketed in 1996. Since then, it has clearly only improved in performance.



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