

Born to run

WATCHING 400M RUNNER OSCAR PISTORIUS COMPETE IS A remarkable spectacle. He comes out of the blocks laboriously, his mouth beneath his trademark wraparound sunglasses compressed with effort. Perceptibly, though, he gathers speed as he rounds the first bend, his muscular Lycra-clad thighs pumping like flesh-and-blood pistons. By the time he enters the last 200m, he is looking more relaxed, visibly at ease in his inexorable, ground-swallowing stride. As he enters the final straight, he appears almost to be gliding, at considerable speed, towards the finish line.

The spectacle is not only remarkable, it is inspiring. Because unlike his rivals, Pistorius is a double lower-leg amputee who runs on carbon-fibre prosthetic limbs. He is a Paralympic champion who holds world records in the 100m, 200m and 400m. So fast are his times that he spent most of this year training to qualify for a place in the Beijing Olympics – in the able-bodied competition. In the end – at the Luzern Spitzenleichtathletik meet on July 16 in Switzerland – he failed to qualify for the individual event by 0.7 seconds and by one position in the 4x400m relay. “I said at the start of the season that I’d be extremely happy just to be running times I was comfortable with, whether I made it to the Olympics or not,” said the 21-year-old South African. “Tonight was certainly one of those times.”

He could afford to be stoic. His mere presence on the track that night marked a victory of another kind. After months of research and debate, during which the decisions of governing bodies were made and then just as quickly overturned, Pistorius had earned the right to pit himself against an able-bodied field for the first time in the history of sport.

His hopes for Beijing are by no means dashed. He begins his defence of his Paralympic crown this week, and will endeavour to secure the gold-medal hat trick that he’s had in his sights since Athens. And as a still-young athlete,

his dream to compete at the London Olympics in 2012 remains intact. With the 2009 IAAF World Championships in Berlin and the 2010 Commonwealth Games in New Delhi just around the corner, Pistorius has plenty of opportunities to prove himself on the international athletics stage. And this means the controversy that still rages in certain quarters about his participation in able-bodied competition isn’t likely to go away any time soon.

PISTORIUS RUNS ON CHEETAH FLEX-FOOT prosthetic legs manufactured by the Icelandic company Ossur, an international leader in prosthetic technology. The legs are so named because their “J” shape resembles the hind legs of a cheetah. They’re commonly referred to as “blades”, leading to Pistorius’s nickname, “Blade Runner”. Recently, he’s been dubbed in the press “the fastest man on no legs”.

Last year, Nike South Africa launched an ad campaign featuring Pistorius among other South African sportspeople, with the tagline, “My body is my weapon. This is how I fight.” But not everyone agrees that Pistorius’s only weapon is his body. There is intense debate about whether Pistorius, running on his prostheses, enjoys an advantage his limb-intact competitors do not. As the first Paralympic runner to approach elite able-bodied times, he’s in a groundbreaking position. The debate has been vigorous, both camps acutely aware that any decision made will set a precedent for similar cases in the future.

In November last year, the IAAF (International Association of Athletics Federations, the interna-

As the fastest man on no legs, Oscar Pistorius, in his quest to compete against able-bodied runners at the Olympics, is forcing the athletics world to confront some very tricky issues. By Edward Ovadia.

tional governing body for athletics) commissioned biomechanist Professor Gert-Peter Brüggemann to run tests on Pistorius in Cologne, Germany. In January, Brüggemann concluded that Pistorius *did* have an advantage, and the Paralympian was promptly banned from able-bodied competition. Pistorius and his team then travelled to Houston, Texas, for testing by associate professors Hugh Herr (himself a double amputee), Rodger Kram and Peter Weyand. Their aim? To investigate the IAAF findings. The Pistorius team took the professors’ research to the Court of Arbitration for Sport (CAS) in Switzerland and, on May 16, the court ruled that the IAAF had not *conclusively* proved Pistorius had an advantage and, consequently, did not have the right to ban him. Pistorius was free to try to qualify for the Beijing Olympics.

OSCAR PISTORIUS WAS BORN ON NOVEMBER 22, 1986, missing the fibula bones and the three outside toes in his lower legs and feet, a condition called congenital longitudinal fibular deficiency. His parents, Sheila and Henke, were faced with the unthinkable possibility of giving surgeons permission to amputate their baby son’s legs below the knee. They visited nine specialists, refusing to accept what would become the only



possible outcome. “I only had one bone where you’re designed to have two,” explains Pistorius now. “Unfortunately, your weight can’t be held by that single bone, so there’s a good chance it will break a lot and become very brittle. They look at your parents and grandparents, and if you’ve got larger family members, they’re better off amputating.”

Eleven months after his birth, the difficult decision was made and the surgery performed. The surgeons removed weight-bearing skin from the soles of the baby’s feet and attached it to the end of his stumps. And so Oscar grew up learning to walk on prosthetic legs – small, wooden, skin-coloured legs attached to a pair of “little Mickey Mouse shoes” that he remembers thinking were “very cool”. Sheila and Henke vowed that their son would never feel disadvantaged. They would go on to teach him that, with or without legs, he could achieve anything he wanted to in life – a sentiment Sheila expressed when Oscar was 17 months old. “Feet cannot earn a good salary or give us a compassionate and loving heart,” she wrote. “A loser is not the one who runs last in the race. It is the one who sits and watches and has never tried to run the race.”

“I don’t know what it would have been like growing up with normal legs,” says Pistorius today. “One of the things I’ve learnt is the way that you perceive yourself is the way other people perceive you. I didn’t think of myself as someone who was disabled or disadvantaged in any way. And I think people accepted me and treated me accordingly.”

“My mum always said to us, ‘The phrase “I can’t” doesn’t exist’, and I think that’s one of the things my parents taught my brother and me from a very young age. It helped me become the person I am today.” Sheila died when Oscar was 15, from an allergic reaction to medication. “I wish she was still here to see what I’ve accomplished,” he says. “I was quite lucky for the time I did get to spend with her.”

THE PISTORIUS MEN WERE ALL SPORTY. HENKE ENJOYED GRECO-Roman wrestling, his father had been a boxer and Carl, Oscar’s older brother, was and still is an extreme-sports enthusiast. “When I was four, I started motocross and off-road biking,” says Pistorius. “And then when I got to school, I did everything: tennis, boxing, rugby.” A boarding student at Pretoria Boys High School, he had no choice but to keep up or be rejected by his peers. “When I got to high school, I ended up playing rugby and water polo. They were the two I enjoyed the most. I never participated in disabled sport.”

It was a rugby injury at age 17 that introduced Oscar to athletics and Paralympic competition. “I was playing a game against another high school in 2003 when I got tackled from the side and hurt cartilage in my ACL [anterior cruciate ligament, in the knee],” he recalls. The doctor who saw him after the fateful injury couldn’t believe Oscar was playing rugby: he’d never seen an amputee compete in such an intense contact sport. “Part of my rehabilitation was to get involved with athletics to get fit for the 2004 rugby season. So I started training, and my coach entered me in a few competitions. Before I knew it, I was hooked.”

Just two months after taking up sprinting, Oscar broke the 100m world record for disabled sprinters by 0.7 seconds (his time, 11.51) at the Pilditch stadium in his home town of Pretoria. Such success was almost unheard of. Six months later he shot to prominence when he won the 200m at the 2004 Paralympics in a world record time. He was only 17 – still sporting dental braces – and a double world record holder. “It was completely unreal and amazing,” he says. “It was something I had been working towards, but it wasn’t something that I really expected.” Last year, after placing second in the 400m against able-bodied runners at the South African Championships (in a highly respectable 46.56 seconds), the idea of competing in the able-bodied Olympics was mooted. He had the times and the results to make this a very real possibility. (In his home country, Pistorius’s inclusion in able-bodied meets had never been questioned prior to the IAAF ruling.)

Pistorius is a national hero in South Africa. He has achieved higher recognition and success than many able-bodied competitors and, in doing so, raised the profile of the Paralympic movement. Underneath the celebrity, though, is a 21-year-old: gregarious, playful and perhaps a little cocky, in the way that a world champion sprinter can be. His blond hair, usually long and tousled, has been shaved short for speed. His body, from the knees up, is a mass of rippling muscles, concealed on the track by a Nike body suit. His sunglasses are a near-permanent fixture.

“This started off just being a fight for me to get to the Olympic Games, but it has ended up being a platform for amputee people,” he says of the recent media interest. “[Amputee athletes] are extremely professional and train just as hard, if not harder, than able-bodied athletes. Everybody is saying that it’s the prosthetic legs that help the athletes to the times they run, but actually it’s the athletes who are working so hard. There has definitely been a sense of discrimination against us. They were saying that having prosthetic legs gives us an advantage, when I know that it doesn’t.”



Fast as a cheetah: (above) critics argue that because carbon fibre doesn’t get tired, Pistorius’s prosthetic legs may in fact give him an advantage.

“Pistorius is more efficient in running... he has to work less than comparable runners at the same speed. Due to his mechanical advantage, he does not need a higher oxygen uptake.”

Almost there: (below) at Lucerne in July, Pistorius failed by just 0.7 seconds to qualify for a place in the Beijing Olympics alongside able-bodied runners.



UNFORTUNATELY, NOT EVERYONE IS AS CONVINCED. Professor Brüggemann, commissioned by the IAAF to carry out the original research, stated that Pistorius uses 25 per cent less energy when running at 400m speeds – an energy saving that he suggests is due to the mechanical advantage of the carbon-fibre blades. He also found that his prostheses return 30 per cent more energy per stride than the human ankle joint and that, when looking at the forces generated with every step, Pistorius was more economical.

“From the biomechanic tests we clearly saw that Pistorius is more efficient in running,” explains Brüggemann. “He needs less vertical force as well as less horizontal braking and propulsion force at constant speeds – which means he has to work less than comparable runners at the same speed. We also measured oxygen uptake at high speeds: Oscar has 25 per cent less. Due to his mechanical advantage, he does not need a higher oxygen uptake.” The IAAF banned Pistorius from able-bodied competition on the basis of these findings.

But professors Herr, Kram and Weyand found numerous flaws in Brüggemann’s theories. In their research, they state that Brüggemann’s methods for assessing oxygen uptake were flawed, and that in a measurable context, Pistorius has energy requirements comparable to able-bodied runners of equal performance. They also question whether the Cheetah prosthetics actually do return more mechanical energy; and further suggest that Pistorius fatigues in a way consistent with able-bodied 400m runners.

“Based on the data,” says Weyand, “the blades do not confer an enhanced ability to hold speed over a 400m race. Nor does our research support the IAAF’s claim of how the blades provide some sort of mechanical advantage for sprinting.”

Dr Ross Tucker is a South African exercise physiologist who has been following closely both sides of the argument. “There are two contractions involved in storing and releasing energy during the running stride,” he explains. “There is a contraction when you land and a second one when you push off. Energy is stored on the landing contraction, and released on the push-off contraction.” The carbon-fibre prosthetic works on a similar basis, but with one important difference: “The Cheetah prosthetics don’t require muscle contraction to store or release energy,” says Tucker. “All it requires is landing. It passively stores energy on impact and releases it in recoil. In human beings, the process is active – there is an energy ‘cost’ – and that’s why we fatigue. What this means is that able-bodied athletes actively expend extra energy every step just to recover the mechanical energy invested. Pistorius simply has passive energy return, requiring no investment of energy.”

Brüggemann concluded that Pistorius’s blades return significantly more energy than the human ankle. “It was clearly shown that in the healthy joint there was much more energy absorbed than generated. The energy lost was around 40 per cent. In the artificial joint, the energy lost was just 8 per cent – so it’s a huge advantage.”

Brüggemann argues that much of that energy loss is dissipated as heat. Herr, on the other hand, believes expelling that much heat every step is impossible. “We’re talking about an enormous amount of lost energy across a 400m race, which is just not likely,” he says. “We have so much frictional forces in the ankle joint which dissipate energy,” counters Brüggemann. “If you try to move the ankle joint of a cadaver, it is very hard to move – the frictional dissipation of energy is very high.”

Given the complex mechanics of the human

body, Weyand suggests that accurately measuring the total energy return is impossible: “We can’t do that for the human limb, because the energy storage and return is distributed among many muscles and tendons rather than a single prosthetic. But we have a number of accounts which suggest that once you get up to a constant speed, the leg functions much like a spring does.”

Although Weyand acknowledges that Pistorius is likely to be getting considerable energy return from his contact with the ground, just as limb-intact runners do, that’s not the whole story. “If you look only at the ankle, it looks like Oscar is getting a lot more energy return. But in able-bodied athletes, there is the possibility of energy transfer to other joints.” Because muscles span multiple joints, energy can be transferred across joints, which means that it is not lost. Herr and Weyand suggest that the “lost” energy may be transferred to the knee joints of able-bodied athletes through the calf muscles – an advantage that Pistorius, who has no lower legs, obviously does not enjoy. Crucially, it was this suggestion that put enough doubt into the minds of the governing body at CAS for them to dismiss Brüggemann’s claims concerning energy return.

Dispute also surrounds the amount of force Pistorius generates. When running, the body uses horizontal force, which acts as a braking force helping to load energy when striking the ground, and a propulsion force when pushing off; and vertical force, which is the amount of force generated on the ground. According to Herr and Weyand, the vertical force is the more important of the two, accounting for five to 10 times that of the horizontal force.

“Four-hundred-metre sprinters with intact limbs apply a very high peak vertical force to the ground,” says Herr. “Oscar has a lower vertical force. I believe this force limitation is caused by his prostheses: calf muscles contribute to high ground forces.” So Pistorius finds it harder to accelerate at the beginning of his races because he has no lower-leg muscles with which to generate force quickly. This certainly accounts for his famously slow starts.

However, Brüggemann also measured Pistorius’s performance against those of able-bodied control sprinters at peak speed, not just through initial acceleration. Here, he maintains, Pistorius requires less force to maintain his speed, and thus fatigues less over the course of a race. “If we look at subjects running at different speeds, it’s logical to say that the higher the force, the higher the speed,” agrees Brüggemann. “But with all subjects running at a given speed, lower force is an advantage.”

And this, he believes, is the case with Pistorius, in relation to both horizontal and vertical forces that he exerts. “He needs less vertical force as well as less horizontal braking and propulsion force – which means he has to work less at the same speed than the control subjects.” Dr Benno Nigg, a leading biomechanist from the University of Calgary in Canada, agrees: “Pistorius lost less energy and had to produce less work during each [instance of] ground contact than the athletes in the control group.”

MUCH HAS BEEN MADE OF THE UNUSUAL FASHION IN WHICH Pistorius runs his 400m races. After losing up to 30 metres on the rest of the field because of an initial difficulty in acceleration coming out of the blocks, he runs the second half faster than the first and, over the final 150m, it’s common to see Pistorius “flying down” the home straight. Many people have taken this as a sign that he does not fatigue in the same way as able-bodied runners.

“The return of energy for Pistorius is non-fatiguable,” explains Tucker, “because all the prosthetics have to do is recoil. Carbon fibre never gets tired. The problem is that human legs *do* fatigue, due to an accumulation of metabolites in the muscle – which Pistorius doesn’t suffer from. What happens to a typical 400m runner is that they get slower and slower as the muscle tendon unit becomes less effective. These metabolites reduce the ability of the muscle to contract, which means that the muscle is less able to produce force. You get progressively less energy returned as the race continues, as well as generating less force on the ground; whereas the carbon fibre stores and releases the same amount of energy throughout the race.”

It’s because of this that almost no able-bodied athletes are capable of running the second half of a 400m race faster than the first half. Yet Herr, Kram and Weyand claim that they demonstrated Pistorius’s ability to maintain speed over longer sprint events as being identical to sprinters with intact limbs. In a test of speed duration, Pistorius’s results were very close to the trend seen in able-bodied runners. These results led the researchers to conclude that Pistorius’s relatively fast late race speeds may not be conferred by his prostheses, but are likely indicative of his lack of calf muscles resulting in a relative difficulty in accelerating from the start.

In any case, no one would disagree that Pistorius has a disadvantage in acceleration at the start – a loss Tucker places at less than a second. “My start is always bad,” says Pistorius, “because I don’t have any ankle movement, so I’m always at a disadvantage there. I would have to expend a lot of energy to maintain a start that is respectable against the athletes who can really blast out of the blocks, so I might as well leave it as it is and focus on the second 200m.”

CAS found the IAAF at fault for not testing other joints, including the hip



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“I have proved all I need to prove”: (above) after the Beijing Paralympics, Pistorius has his sights set on the London Olympics.

and the knee joints. The theory goes that while Pistorius may be more efficient in his “ankle”, his hip and knee joints may be overcompensating and working harder than those in able-bodied athletes. “When you amputate a human being’s leg,” explains Herr, “and you put this foreign object on it – the prosthesis – you can’t expect the remaining part of the body to behave in the same way. It forces the rest of the body to work in a different and often non-optimal way.”

It seems the only area of agreement between the two camps is that the study of biomechanics is still an imprecise science and this poses an inherent difficulty in making a decision. The only experiment that would conclusively prove a performance advantage or disadvantage would be to “magically give Oscar back his biological legs, and recreate his history on those legs; and then pair that Oscar against the real Oscar with blades, and see who wins the 400m race,” explains Herr. “That question may not be answerable.”

In his more philosophical moments, Herr suggests that this obsession with fairness may be taking things too far. “If you make sport completely fair,” he says, “there would be no competition, no sport, the runners would all cross the finish line at the exact same moment. We find sport exciting because it *is* unfair.”

He may have a point. It’s impossible to ignore the similarities between the Oscar Pistorius debate and the issues that surround the Speedo LZR Racer suit which has revolutionised the swimming world. In both situations, if an advantage is shown to exist – as it clearly does with the suit – we are edging ever closer to the line of technological doping. How much technology is too much, especially in sports that are supposed to be based solely on pure human movements?

A key point of the CAS ruling was that it applied only to the exact prosthetics measured. If even the slightest aspect of them were to be changed, the blades would have to be re-submitted for further testing. This puts the IAAF in a very difficult position: “If Ossur develops a new, improved prosthetic, how else will the governing bodies be able to assess it other than to do an entirely new research study – which cost A50,000 the first time around?” asks Tucker.

Pursuing his eligibility to race in the Beijing Olympics consumed so much of his time that Pistorius missed valuable months of training. As such, he was left with only three attempts to qualify. In Lucerne, he came remarkably close. For now, though, he’s done arguing over the technicalities. “It is not my problem any more,” he says. “I have proved all I need to prove. My job is to be on the track and enjoy what I do.”

Advantage or not, there’s no doubt that seeing Pistorius running in able-bodied competition, pumping his metallic blades alongside the muscled legs of his competitors, is enough to make us warm to one of the greatest underdogs international sport has seen. Pistorius will have his chance next year at the IAAF World Championships and will be a regular come the 2010 Commonwealth Games. But it’s still the Olympics that holds the most important place in his heart.

“It’s the realisation of a goal I’ve been trying to achieve for many years,” he says. “It’s the biggest single sporting event in the world, and that’s what I’ve set my sights on for the future.” He acknowledges Beijing may have been a long shot, but says London in 2012 is a very realistic goal.

“Sprinters peak at 27 to 29,” explains Pistorius. “I’ll be 25 in London and that will be the beginning of the peak.” **GW**