Blade Runner

His legs were amputated when he was a year old. Now Oscar Pistorius is on track to make the South African Olympic team. Is he an engineering marvel — or just one hell of a sprinter?

By Josh McHugh

Story Images

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Fast Track

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I first hear it as I'm coming out of a turn on the track at the University of Pretoria's High Performance Centre. It's 100 meters to the finish line. I'm pumping my legs as fast as I can when a sort of *snick snick snick snick* starts getting louder, like I'm being chased by a giant pair of scissors. At 50 meters to go, the sound is at my left shoulder, and then Oscar Pistorius blows past me; the *snick snick* fades away ahead. By the time I cross the finish line, the South African sprinter has already turned around and is catching his breath, leaning forward, hands on his knees.

He ran 200 meters. I ran only 150; he spotted me the difference. Still, his win comes as no surprise. Two years ago Pistorius ran the 200 in 21.34 seconds, matching the women's world record time set by Florence Griffith Joyner in 1988 and missing the qualifying time for the 2008 Olympics by just three-quarters of a second.

"Nice running, bru," Pistorius says in his Afrikaans-tinged lilt. Then he turns his attention

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Footage by Baerbel Schmidt. Music by Michael Calore.

to a pair of sprinters from the women's track team, stretching before their workout. He suggests they upgrade to more streamlined running gear: bikinis. "Naughty!" one of them squeals, tousling his frosted curly hair.

Pistorius and I grab bottles of water, and then he trots to the infield. He sits, undoes a couple of straps, and tosses his legs onto the grass. The Cheetahs, elegant, swooping lengths of carbon-fiber composite, are better at running than walking.

I'm not the only runner who has learned to dread the scissoring sound of Oscar Pistorius. Marlon Shirley and Brian Frasure, both of whom are below-the-knee single amputees, were the world's top two runners going into the Athens Paralympics in 2004. Shirley finished in 22.67 seconds, breaking Frasure's world record for a one-legged amputee. But they were racing for silver. Three strides ahead, Pistorius had demolished them both, clocking a time of 21.97.

Since Athens, Pistorius has been running in Paralympic events, but also against able-bodied runners. After overhauling his training regimen and working with redesigned, customized prototype prosthetics, Pistorius is on pace to run the 200- and 400-meter sprints fast enough to earn a spot on South Africa's Olympic team. He'd be the first amputee runner to cross over.

Pistorius is forcing the sports world to rethink what it means to be a disabled athlete. Is he so close to world-class that his limitations, his prosthetic legs, represent a disadvantage? Or are the Cheetahs an advantage, an artificial enhancement that makes him faster than he would be if he had natural legs? After all, improvements in human performance are normally limited by biology and evolution. Not in Pistorius' case. His legs are constantly upgraded by a pit crew of Icelandic gearheads at one of the world's most sophisticated prosthetic manufacturing facilities.

No one expects able-bodied runners to compete head-to-head with wheelchair-bound marathoners. The wheels confer an obvious speed advantage, and maybe Oscar Pistorius' Cheetahs do, too. So the real question is this: Do able-bodied athletes need protection from him?

Pistorius was born in Johannesburg, South Africa, in 1986, with five digits on each hand and two toes on each tiny foot. Each leg was missing its fibula, the long, thin bone that anchors the calf muscle and forms the outside of the ankle. His parents had a choice: consign their child to a wheelchair or amputate his lower legs and let him learn to walk with prosthetics.

His father, Henke, head of the family's zinc-mining company, asked a dozen orthopedic surgeons which three doctors in the world they would choose to perform a lower-leg amputation on their own child. Of the top three they named, two were in the US and one was in South Africa. A month before Oscar's first birthday, Gerry Versveld removed the baby boy's legs halfway between his knees and ankles. Six months later, Oscar took his first steps, on a pair of fiberglass pegs.

Spending a week with Pistorius makes you feel slow in all sorts of ways. When I hear he is going to pick me up at the airport, I figure someone will drive him there to meet me, or maybe he'll be driving a car modified with hand controls for accelerating and braking. I am mistaken.

As I emerge from customs, he picks me out of the blinking crowd with a shout, grabs my

suitcase, and bounds up a set of stairs ahead of me on a pair of "street" prosthetics. I look surreptitiously at his baggy jeans for some sign that he doesn't have biological legs. Maybe he looks a little bowlegged.

His car is modified, but not in the way I'd imagined. It's a little black sled straight out of *The Fast and the Furious* — a low-slung, five-speed manual SEAT Ibiza hatchback with about 4 inches of ground clearance. oscar pistorius is emblazoned across the doors in 6-inch-high white letters above the name of his sponsor, Hatfield Motors.

Slaloming along the N1 freeway between Pretoria and Johannesburg at about 125 percent of the speed limit, Pistorius hands me his cell phone to show me a text message he just received. "I go back to Denmark in 2 weeks. I want to have as much fun as possible before I go. What are u doing 2nite?" He tells me he's going to decline this invitation — he's quite sweet on his current girlfriend — but he can't resist texting back, one hand (thankfully) still on the wheel, to inquire what she has in mind. He passes her reply over for my perusal: "I cd tell u but it would be much easier to show u!"

Later, while Pistorius is parking his little rocket at a coffee shop, I ask whether sometimes, maybe if he's in a huge hurry, he ever parks in handicap spaces.

"Yoh! Never," he almost spits. "There's nothing that cheeses me off worse than seeing somebody pull into a disabled spot, then get out of their car and walk off.

"People ask me all the time if I wish I had the rest of my legs," Pistorius continues. "No. I guess it's a kind of an inconvenience, having to put on different legs to do different things, but there's nothing that anyone else can do that I can't do."

Sometimes his managers and coaches wish Pistorius would do a little less. Last spring his then–business manager Lizl Schutte chewed him out when she learned he'd spent the weekend on an ATV bike, competing with friends to see who could launch themselves the farthest off a ramp into a lake. Steven Ball, his strength trainer, reports that although Pistorius has been destroying Paralympics records for two years, he began a hardcore weight training program only a year ago. Ampie Louw, Pistorius' running coach since 2003, says the biggest thing standing between the sprinter and the two seconds he needs to cut from his time in the 400 meters to make the Olympics may be his robust social life.

"Getting him to come here and train every day — that's the challenge," Louw says with a rueful laugh. "Look at the best sprinters' upper bodies, and look at Oscar's. We're not matching the Asafa Powells yet." Two seconds is about 5 percent of a world-class time in the 400, no small improvement for Pistorius. But Louw is convinced he can do it. Since 2004 Pistorius has trimmed more than three seconds off his time in the 400, and Louw is still working to correct a persistent problem in his running mechanics. "He always wants to make his stride too long," Louw says. "It puts enormous pressure on his hamstrings, and he spends too much time in the air." A new pair of Cheetahs, specially designed for use by double amputees, might also help.

At the track for a workout, Pistorius opens the hatch of his car and takes out the new legs. The South African flag is emblazoned on the sockets that grip Pistorius' stumps; there's a line of 2-inch-high foam-rubber pyramids down the rear face of the blades with a plastic wire connecting the points. Pistorius says he and Trevor Brauckmann, the man who builds and fits those sockets, are going to stretch fabric across the framework in an attempt to cut down wind resistance — in other words, he's going to add aerodynamic cowling. Just another enhancement.

A company called Flex-Foot debuted the Cheetah in 1996, but the prosthetic blades remained a bit crude until Flex-Foot was acquired by the Icelandic firm Ossur in 2000. If you are missing a leg, owning an Ossur is like driving a BMW M-series.

The current Cheetahs look a little like the rear leg of a horse or cat, extending straight down from the socket, cantilevering backward, and then angling forward sharply. But last September, Pistorius and Brauckmann went to Reykjavik to test prototypes designed for double

amputees. The new ones, which Pistorius hasn't debuted at a major race yet, make just one smooth curve, an arc of pure engineering.

Ossur's R&D team met them at the company's workshop and unveiled the prototypes. Brauckmann attached the blades to the sockets, and Pistorius walked around on them, testing the design.

They were too soft, Brauckmann told Ari Clausen, an engineer at Ossur. Oscar would to break them.

Clausen didn't believe it. His team had factored in every force Pistorius could possibly apply to the carbon fiber. So the next day, Pistorius put them on, jogged a bit, and cracked them. Clausen built a new set; that afternoon he took the South Africans to a track to try out the replacements — Brauckmann had doubts about the new pair as well, but Pistorius wanted to give them a try. He strapped in, stretched a bit, and started to jog.

When Pistorius falls while running, it's less like a stumble and more like a skiing wipeout. A few months before the Reykjavik trip, at a training day in South Africa, one of his blades split with a sound like a snapping two-by-four. He hit the rubber track going about 25 miles an hour, and bounced and slid 10 yards before stopping. He didn't break any bones, but the road burn took weeks to heal.

This time, as Pistorius started running he heard some creaking noises from his right leg — something felt wrong. Sure enough, the blade splintered. But this time Pistorius was able to pull up and slow down. He avoided the fall and hopped back to a chagrined Clausen, who tossed the prototypes into his huge tundra-and-magma- field-crawling Dodge Ram pickup and headed back to the workshop.

The testing room at Ossur is a bustling space where titanium-jointed prosthetic legs are stacked under racks of silicone feet and hands in various skin tones. It looks like Geppetto's workshop, if Geppetto were building an army of life-size super puppets. On my first look around, I see a guy sitting at a workbench, tightening screws that attach a prosthetic foot to a computer-controlled bionic knee called the Rheo. It's a joint project between Ossur and the MIT Media Lab. The man swivels in his chair, fastens the bionic leg to the stump of his left leg, stands up, and walks out of the room. I catch up to him on his way back after he's tried out his tweaked Rheo on a set of stairs. His name is Gísli Jónsson; he's a technician at Ossur.

What's the best thing about the Rheo? I ask.

"I don't fall down anymore," Jónsson says. "Even after I've been drinking."

Pistorius' Cheetah blades aren't particularly well-suited for a night of debauchery, and they don't have any of the sophisticated electronics software or servos of a Rheo. They are purpose-built, starting their life at Ossur as rolls of resin-impregnated (or "pre-preg") carbon fiber, stored in a van-sized industrial freezer. The rolls are cut into square sheets and pressed onto the outside of a steel mold milled in the shape of the legs' final profile.

Depending on the size of the athlete the blades are being made for, anywhere from 30 to 90 carbon-fiber sheets are layered one on top of another. Then the whole thing is swung into an autoclave that melts and fuses the resin and sheets into a solid, contoured carbon-fiber plate. Using pre-preg sheets instead of adding resin cuts down on air bubbles that can cause breaks. Once the compound cools, a robotic arm with a high-pressure water jet on the end carves the now-curved sheet into several Cheetah legs. Each one costs between $15,000 and $18,000.

To give me a sense of how they feel, Ossur's engineers bolt a pair of Cheetahs to the back of two rigid plastic-and-leather motorcycle boots. I clamp in and trot across the room a few times. The Cheetahs seem to bounce of their own accord. It's impossible to stand still on them, and difficult to move slowly. Once they get going, Cheetahs are extremely hard to control.

It shouldn't come as any surprise that the most highly functional prosthetic limbs come from Iceland. It's not a culture that embraces self-pity or, as far as I could tell from my week in Reykjavik, any pity at all. Iceland has just begun killing whales again after a 20-year hiatus, and nearly every Icelander I talk to is mystified by the international condemnation aimed at

their tiny country. Mothers sit in Reykjavik's restaurants devouring smoked puffin, casting occasional glances through the window at their heavily swaddled babies in carriages parked on the sidewalk in the cold wind.

There's a word in Icelandic: *upphafning*. Literally it means "elevation," but when the folks at Ossur use it, it's more like "self- elevation." Cutting slack to someone who's disabled is frowned upon here — pity is just condescension by another name.

Pistorius says he wouldn't change a thing about his life — he's a world-class athlete and bona fide celebrity in South Africa who gets pestered for autographs and ogled by girls. Just one problem: Pistorius wishes that his carbon-fiber prostheses were beside the point. That's not likely. They'll be precisely the point when the world's best able-bodied sprinters start losing heats to a bilateral lower-leg amputee.

If only because of their shape, the Cheetahs, especially when they are lined up at the starting blocks next to seven pairs of biological legs, elicit amazement and fear. They look dangerous. Bionic legs! Part man, part machine! The twin ghosts of Steve Austin and John Henry (well, not twins exactly, but you see what I mean) will always dog Pistorius.

Eventually, sports fans might be made to comprehend the distinction between bionics — mechanical joints with moving parts, microprocessors, and power sources — and what Pistorius runs on: pegs. Hyper-engineered, autoclave-forged, epoxy-impregnated, elastic pegs, but still really just pegs.

But even that recognition might not be enough to quell concerns that Cheetahs confer an advantage. After he blew past them in Athens, Americans Shirley and Frasure accused Pistorius of "running tall": adding length to his stride by using longer prosthetics. "He's able to manipulate something that's out of other athletes' control," Shirley told *Sports Illustrated*. "Just because he has a double amputation, why should he have a different set of rules?" It was a spurious accusation; both men are, like Pistorius, sponsored by Ossur. They know, or ought to know, that Cheetahs have to be longer than biological legs. Nature built the ankle as a hinge that compresses and extends with every step, but Cheetahs supplant that localized up-and-down movement with elastic compression along their entire curve ... which means Cheetah users are permanently on tiptoe.

Perhaps more important, the limits of the human body — any human body — are a matter of math. It takes 3,556 joules to move 80.5 kilograms, Pistorius' weight, at 9.4 meters per second. That's his average speed on his fastest 200-meter run. Those joules have to come from somewhere. Running is basically a matter of forcing that power into the legs and using them, springlike, to bounce the body forward.

The lower legs of able-bodied sprinters return all the energy pumped into them by the muscles at the hips and knees — and they give back more, thanks to power from the calves and ankles. Pistorius doesn't have feet, ankles, or calves, of course, so he compensates: His strength trainer estimates that 85 percent of his power comes from his hips and the rest comes from the knees. That hip- generated stride, combined with the odd shape of the Cheetah itself, means that Pistorius has to waddle slightly, his feet flailing out to the side a bit on each rearward kick. The blades make that scissoring noise as they grip the track, compress, and return to their original shape.

Pistorius' street legs are modeled and painted to look as much like natural legs as possible, color-matched to his thighs. But covered by the flesh-tone paint is a doodled-on depiction of calf muscle a friend inked in red and black permanent marker before the Athens Paralympics. It's an interesting tattoo, a reminder that no matter how good Cheetahs are, Pistorius is still missing a natural calf.

So, sure, artificial legs are lighter than natural ones. Pistorius will never blow out his ankles or break a toe, though presumably his knees are as vulnerable as anyone's to old age and trauma. But does any of that constitute an unfair advantage? Does being able to modify and tune a prosthetic limb belong to the same category as blood doping (banned) or altitude

training (A-OK)? If there's an issue of fairness here at all, it's not that Pistorius is using technology superior to what evolution has built for human beings. As Robert Gailey, who studies the biomechanics of prosthetics at the University of Miami, puts it, running on stilts isn't exactly a plus. The real asymmetry is that Frasure and Shirley each still have one natural leg, and it's holding them back.

You can see it when they run. Mixed-leg sprinters piston up and down, energy lost to vertical movement when they're trying to go horizontal. When Pistorius runs, his gait has a circular smoothness. He looks like he's on wheels. (Watch Pistorius run at wired.com /extras.) And while runners lose speed coming out of a turn as they straighten up, Louw thinks that Pistorius may actually be able to use that inward lean to push more energy into the Cheetahs. He'd come out of a turn going *faster*.

Sitting in the stands overlooking the track in Pretoria, Pistorius admits to some of his shortcomings as a runner. The 100-meter will never be his event: It takes him too long to get the right rhythm going, and the top single-amputee sprinters (not to mention the able-bodied ones) will probably continue to beat him. No, for Pistorius it'll be the 200 and the 400.

The first 30 meters, he says, are all about keeping his head down and taking short, quick strides. Then he upshifts, breaking each curve into three straight lines and hitting the afterburners in the stretch. He points to the stride patterns of Michael Johnson, the drug-enhanced sprinter's physique of Tim Montgomery, and the all-around greatness of current champ Asafa Powell. All the people he wants to emulate are able-bodied.

"I have full respect for the Paralympics," Pistorius says. "But I tell people this all the time: You'll never progress if your mind is on your disability."

But he's a Paralympic champion, I say.

"I'd really like to dominate the Paralympics until the end of my career," he answers. "But in able-bodied racing, I'd like to be a known name for a long time."

In November, John Einmahl and Jan Magnus, econometrics professors at the Netherlands' Tilburg University, released an article called "Records in Athletics Through Extreme-Value Theory." In the paper — which hasn't been accepted for publication yet — they apply probability theory to the peak performances of thousands of athletes over time in 14 track and field events to determine the extreme values, or the limits, of athletic capability. In some events, their models showed that current world records are fairly close to the limits. They model the fastest-possible men's marathon time as 2:04:06, only 49 seconds, or 0.7 percent, faster than the current world record. In other events, the models predict a major improvement — the limit to the men's 100 meters is 9.29 seconds, they say, and the current world record is a dawdling 9.77, a difference of 5 percent.

True, sports statisticians are always drawing graphs like this. Charts of world-record performances do indeed tend to look asymptotic, forever approaching but never reaching some theoretical limit. But the curve of records laid down by Paralympic athletes, Pistorius in particular, is approaching the limit line much more rapidly and at a much steeper angle. The average track and field world record for able-bodied athletes is nine years old for men and 10 for women; in Paralympics track and field events, that number is just two years. Every time amputee jocks get together for a major meet, they break half of the world records on their books.

It's also true that the Cheetahs Pistorius hopes to run on in Beijing, with their pure-engineering swoop, are in quantifiable ways better — faster — than the ones he ran on in Athens. Does that bother you? Pistorius' handlers have a saying: If you think having carbon-fiber legs will make you a faster sprinter, have the operation and we'll see you at the track. In their eyes, Cheetahs — for all their sophistication — are a disadvantage that Pistorius has transcended.

The International Association of Athletics Federations is supposed to decide if Pistorius is eligible for the Olympics this spring. The possibilities: If Pistorius is a black swan, a statistical

freak who would have been a world-class sprinter on natural legs, too, then no problem — let him run. And, if being an amputee is what gave Pistorius something to prove and turned him into a world-class sprinter, then no problem — let him run. But if he is the vanguard of a legion of plastic track-and-field terminators whose upper speed is a function of materials science and software instead of determination and training? The International Olympics Commission better start hiring some engineers.

Back at the track, Pistorius scissors around a turn, halfway through half a dozen 300-meter reps. Louw whistles through two fingers and barks at the runner to shorten his strides. Pistorius doesn't seem to hear. He accelerates, muscles and carbon fiber reaching in unison toward a point just beyond the finish line.

Contributing editor Josh McHugh (www.joshmchugh.net) wrote about running a faster mile in issue 15.01.

BBC SPORT

'Blade Runner' handed Olympic ban

Paralympic 400m star Oscar Pistorius has failed in his bid to compete at this year's Olympic Games in Beijing.

The IAAF, athletics' governing body, ruled his prosthetic limbs give him an advantage over able-bodied opponents and contravene rules on technical aids.

A scientific study revealed that Pistorius, nicknamed "Blade Runner", used 25% less energy than able-bodied runners to run at the same speed.

The 21-year-old South African said last week he would appeal against any ban.

Paralympic gold medalist Pistorius training for Beijing

"I feel that it is my responsibility, on behalf of other disabled athletes, to stand firm," he said. "I will appeal [against] this decision at the highest levels, while also continuing with my quest to race in the Paralympic Games and hopefully the Olympic Games."

> **The onus is now on us to prove that he is not getting an advantage**
> Agent Peet van Zyl

His agent Peet van Zyl told BBC Sport that he and Pistorius would sit down with their legal team to decide how to take their case forward.

"We are obviously very disappointed," Van Zyl said. "We were really hoping that he would be allowed (to compete).

"The natural feeling from our side is to appeal the verdict. The onus is now on us to prove that he is not getting an advantage."

It is likely that Pistorius will lodge an appeal to the Court of Arbitration for Sport (CAS).

Pistorius, who holds the Paralympic world record of 46.34 seconds, spent two days in Cologne last November undergoing tests alongside five able-bodied athletes of similar ability.

Professor Peter Bruggemann's research concluded an athlete using the "Cheetah prosthetic" could run at the same speed as able-bodied athletes but use less energy.

The tests also revealed that running with prosthetic blades led to less vertical motion combined with 30% less mechanical work for lifting the body.

Based on this and other test results, it was decided the blades should be considered as technical aids in clear contravention of IAAF rules.

Last year, the IAAF banned the use of any device incorporating springs, wheels "or any other element that provides the user with an advantage over another athlete not using such a device".

ZL

The IAAF's decision means that Pistorius will not be allowed to run in any competitions involving able-bodied athletes.

Last summer he finished second in a 'B' race in 46.90 seconds at the Rome Golden League in July and, two days later, was disqualified for running out of his lane in Sheffield.

Pistorius was 11 months old when his legs were amputated below the knee but only began running competitively on the carbon fibre blades four years ago.

He had immediate success winning the 200m at the Athens Paralympic Games and bronze in the 100m.

The South African also holds Paralympic world records for the 200m (21.58secs) and 100m (10.91secs).

He has come close to times set by able-bodied athletes but has yet to attain the Olympic qualifying time over 400m.

Pistorius's Paralympic world record of 46.34 seconds is also some way off the best able-bodies athletes.

The fastest active athlete is American Jeremy Wariner, whose best time is 43.50secs, while fellow countryman Michael Johnson holds the world record at 43.18.

At last year's BBC Sports Personality of the Year awards, Pistorius won the Helen Rollason Award, given annually to an athlete showing courage in the face of adversity.

Story from BBC SPORT:
http://news.bbc.co.uk/go/pr/fr/-/sport2/hi/olympics/athletics/7141302.stm

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Oscar Pistorius: Amputee Sprinter Runs Differently

ScienceDaily (Aug. 4, 2009) — A team of experts in biomechanics and physiology that conducted experiments on Oscar Pistorius, the South African bilateral amputee track athlete, have just published their findings in the *Journal of Applied Physiology*. Some of their previously confidential findings were presented to the Court of Arbitration for Sport (CAS) in Lausanne, Switzerland in May of 2008. Other findings are now being released for the first time.

A portion of the team's findings had been presented at the CAS to appeal the eligibility ban that had been imposed on Pistorius by the International Association of Athletics Federations (IAAF) barring him from sanctioned competitions, including the Olympics and World Championships.

The IAAF had claimed that the Cheetah Flex-Foot prostheses (J-shaped, high-performance prostheses used for running) worn by Pistorius give him an advantage over able-bodied runners.

The appeal was successfully presented on behalf of Pistorius by the international law firm of Dewey & LeBoeuf, who took the case on a pro-bono basis. The CAS concluded that

Peter Weyand, now associate professor of applied physiology and biomechanics at SMU, observes Oscar Pistorius on the treadmill at the Rice University Locomotion Laboratory in Houston. The biomechanics and physiology research team submitted its findings to the Court of Arbitration

the IAAF failed to prove that the biomechanical effects of the Cheetah prostheses give Pistorius an advantage over other athletes not using the prostheses.

for Sport in May 2008. (Credit: Jeff Fitlow/Rice)

The authors of the study are Peter Weyand of Southern Methodist University, Matthew Bundle of the University of Wyoming, Craig McGowan of the University of Texas at Austin, Alena Grabowski and Hugh Herr of the Massachusetts Institute of Technology, Mary Beth Brown of Georgia Institute of Technology and Rodger Kram of the University of Colorado at Boulder. None of the authors received compensation for the research or work on behalf of the CAS hearing. The group agreed to conduct the experiments with the understanding that they would be able to publish their scientific findings after the CAS ruling.

The experiments were conducted at the Locomotion Laboratory of Rice University in Houston, Texas.

The scientific team compared Oscar Pistorius to track athletes with intact limbs to evaluate his:

- Energy cost of running
- Fatigue resistance
- Sprinting mechanics

The team concluded that:

- Pistorius' energy cost of running is similar to that of accomplished male distance runners, but 17% lower than that of performance-matched male sprinters.
- Pistorius' ability to hold his speed over longer sprint races is identical to that of intact-limb athletes.
- Pistorius sprinting mechanics are markedly dissimilar to intact-limb track athletes.

At top speed:

- He exerts considerably less force on the ground in relation to his body weight than intact-limb runners.
- His foot is in contact with the ground 14% longer on each sprinting step
- He spends 34% less time in the air between steps
- He takes 21% less time to reposition (swing) his legs between steps.

In summary, the team concluded that Pistorius' physiology (energy cost and

fatigability) is generally similar to that of intact-limb athletes, but his sprint running mechanics are markedly dissimilar.

The lead author of the study, Dr. Peter Weyand, indicated "I am pleased that we can now completely disclose our results because our study includes critical new data not presented in the CAS eligibility hearing. In addition to informing an interested public, full disclosure is in the best interests of Oscar Pistorius, other track athletes and the sport of Track and Field. The controversy raised by Oscar's inspiring performances presents a pivotal case for the future regulation of prosthetic and other technology in organized athletics. Accordingly, disseminating all the available facts is essential. I am relieved that all of our data are now available, particularly the mechanical data that are most relevant to the controversy and which were not part of the CAS hearing."

Weyand is an Associate Professor in Department of Applied Physiology and Wellness at the Simmons School of Education and Human Development at Southern Methodist University in Dallas, Texas.

Adapted from materials provided by Southern Methodist University.

Southern Methodist University (2009, August 4). Oscar Pistorius: Amputee Sprinter Runs Differently. *ScienceDaily*. Retrieved November 9, 2009, from http://www.sciencedaily.com/releases/2009/06/090629132200.htm

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Notion That Amputee Runners Gain Advantage From Protheses Further Disputed

ScienceDaily (Nov. 9, 2009) — A study by six researchers, including a University of Colorado at Boulder associate professor and his former doctoral student, shows that amputees who use running-specific prosthetic legs have no performance advantage over counterparts who use their biological legs.

Oscar Pistorius. Amputees who use running-specific prosthetic legs have no performance advantage over counterparts who use their biological legs, according to new research. (Credit: Image courtesy of University of Colorado at Boulder)

A debate on the matter was spurred when Oscar Pistorius, a bilateral amputee, was barred from the 400-meter dash at the 2008 Olympic Games in Beijing, and other able-body races. The International Association of Athletics Federations that barred Pistorius claimed his Cheetah Flex-Foot prostheses provided significant advantages over non-amputee competitors, agreeing with other studies that found prostheses reduce the energy cost of running. In addition, some have proposed that the lighter weight of specially designed sport prostheses facilitates a quicker swing of the leg.

The new study was published Nov. 4 in *Biology Letters,* a journal of the Royal Society in London, and is co-authored by Alena Grabowski and Hugh Herr of the Massachusetts Institute of Technology, Craig McGowan of the University of

Texas at Austin, William McDermott of The Orthopedic Specialty Hospital in Murray, Utah, and Rodger Kram of CU-Boulder's department of integrative physiology and its Locomotion Laboratory. Grabowski, lead author on the study, received her doctoral degree in integrative physiology at CU-Boulder under Kram in 2007.

After Pistorius was barred from the Olympic Games in January of last year, the U.S. research team presented findings in April 2008 to the Court of Arbitration for Sport in Lausanne, Switzerland, that were key in the reversal of the ban on Pistorius.

"We have already shown that Pistorius runs differently in terms of his biomechanics," said Kram. "Now we have much more clear evidence that his prosthetic legs incur significant disadvantages."

Data in the study include new measurements taken from an analysis of six unilateral amputees. The comparison of the amputees' prosthetic legs to their biological legs provided a more controlled test, according to Kram.

The researchers measured forces exerted on the ground and leg "swing times" while the unilateral amputees ran on a high-speed treadmill at The Orthopedic Specialty Hospital. The running-specific prostheses impaired the force production of runners by an average of 9 percent. Force production is generally believed to be the key factor behind running speed. No differences in leg swing times were measured.

One of Kram's undergraduate students, Matt Beale, also analyzed video from the 2008 Olympic and Paralympic Games.

"We found that Pistorius and the other amputee sprinters have leg swing times for both their prosthetic and biological legs that are very similar to those of Usain Bolt," said Kram. "We think the amputees learn that swinging their legs rapidly can help to partially compensate for their force disadvantage."

Journal reference:

1. Craig P. McGowan, William J. McDermott, Matthew T. Beale, Rodger Kram, and Hugh M. Herr. **Running-specific prostheses limit ground-force during sprinting**. *Biol. Lett.*, Published online before print November 4, 2009 DOI: 10.1098/rsbl.2009.0729

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