The bionic future of sport

From tennis rackets to carbon fiber prosthetics, materials science has an important role to play in sport.

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Oscar Pistorius has no legs, and yet with the aid of carbon fiber prosthetics has dominated disabled sprint competitions for years. Now he wants to compete against able-bodied athletes in the next Olympics. If he is allowed to do so, it will mark a turning point in the history of sport. If he wins an Olympic medal, all hell will break loose, and he will usher in a new age of bionic sport in which technology is merged with human capabilities.

Materials science and sport have been intertwined ever since sportsmen and women have had the time to engage in non-lethal competitions of courage, strength, human endurance, and skill. This is because most sports have been unable to resist the temptation to innovate. Golf clubs have mutated from wood, to steel, to metal-matrix composites, to metal glasses. Tennis rackets have moved from wood to aluminum, to carbon fiber, with the strings changing from cat gut to synthetics. The running shoe itself has gone from leather, to rubber, and finally to an air-cushioned polyurethane foam with a breathable nylon upper. Running on an air cushion may have developed to increase comfort and safety, but it has also been shown that these shoes reduce the oxygen consumption of marathon runners. The pneumatic tire did the same trick for the bicycle in 1889, although in reverse: it was adopted by professional cyclists because it increased their speed, and then entered the mainstream because of its greater comfort and safety.

Lately, performance is being judged not just by short-term safety aspects, but also the long-term injury effects of certain materials. For instance, it has been realized that the long-term impact of soccer boots over a whole season can influence the probability of injury. Metatarsal injuries such as those suffered by David Beckham prior to the 2002 World Cup and by Wayne Rooney prior to the 2006 World Cup, can be mitigated through boot design, specifically the location of the studs on the sole. Biomechanical modeling of individual players’ feet to design the ideal layout and location of studs means that boots can be tailor-made for individual players and even playing surfaces. Companies now exist that specialize in three-dimensional scanning of the foot, computer modeling bespoke soccer boots, which are then rapid prototyped on demand for players.

Most such innovations start out expensive ventures. For this reason, some sports have banned further materials innovation on the grounds that it starts to bias wealthy teams and individuals. This happened in bicycle racing in the 1990s when materials scientists and engineers started to produce bikes with ever more aerodynamic shapes, often achieved through use of carbon-fiber structures. These designs were particularly useful in time-trial events and their development probably reached its zenith with Chris Boardman, Graeme Obree, and others’ attempts on ‘The Hour’ record. This competition seeks to determine the furthest a human being can travel in one hour under their own power. The banning of these bikes by the Union Cyclist International perhaps represented more than just a fear that high-tech teams would dominate the sport, but also that sport should not be about technology.

Formula One has taken the opposite approach to the innovation offered by science, by making mastery of technology part of the sport, with constant changes in the rules forcing further innovations in car design. The balance between technology advances and driver skill is the key to making the sport such an enticing spectacle. Indeed, it is the total integration of driver and car that provides the surreal frisson of the sport, conjuring up Flann O’Brien’s classic The Third Policeman.

Oscar Pistorius is another example of this trend. He is at the vanguard of effects to make the human body a bionic entity, something that will almost certainly become the norm in the 21st century as material science advances in tissue engineering, bioscaffolding, and robotics continue. If the Olympic committee ban Pistorius, will they not also have to regulate the use of all footwear, afterall aren’t his prosthetics passive walking aids just like a running shoe? If such courageous sportsmen and women are to be excluded from the Olympics, it will confirm that the competition is no longer in touch with human aspirations, which are not about obtaining some idealized human perfection, but rather about winning through against fantastic odds. Technology has always been an expression of the human spirit precisely for this reason.

I, for one, am excited about our bionic future. I remember very clearly watching the 1970s TV series Six Million Dollar Man. At school, every time someone got injured playing rugby, we would run over and chant, “We can rebuild him...we have the technology,” over the stretcher as the ambulance took them away. It was fiction then, but it may soon become fact. In which case, it may not just be physiotherapists that feature on the bench of sports teams, materials scientists and engineers may end up wearing tracksuits too.