Bionic Humans?
Written by Tim Lougheed for Science Alberta Foundation

The Six Million Dollar Man entered the realm of science fiction in the 1970s, and although he would undoubtedly cost far more to build today, dramatic improvements in computing power have brought us much closer to creating just this kind of "bionic" human. Engineers and medical researchers continue to hone the capabilities of artificial arms and legs, helping individuals recover abilities lost to disease or accident.

At the same time, the latest progress in this field has moved in an entirely different direction — inside our bodies. A new generation of prosthetic devices can be implanted within the brain and elsewhere, compensating for damage that leaves someone unable to control their movements or altogether paralysed.

Unlike installing a piece of high-tech hardware for a missing limb, such implants may be all but invisible. Nevertheless, they can dramatically improve the quality of life for many people, often in the most fundamental and significant ways.

Just ask the hundreds of individuals who have benefitted from the WalkAide, an invention pioneered by Richard Stein, a member of the University of Alberta's Faculty of Medicine and Dentistry. This device triggers leg muscles to avoid the problem of drop foot, a condition brought on when the central nervous system no longer responds to the needs of normal walking movements. The system makes safe, secure walking possible for these people, who were constantly faced with the hazards of falling.

More subtle — but no less significant — has been an innovation ushered in by Stein's faculty colleague, Vivian Mushahwar. She has designed "smart underwear," a device that prompts regular muscle movements in the buttocks of paralysed individuals, who are at risk of developing serious skin ulcers caused by the constant pressure of sitting in one position and feeling no discomfort even as these sores become infected. This technology can therefore prevent complications such as blood poisoning, which eventually led to the death of actor Christopher Reeve, who became a quadriplegic after a riding injury.

An even more direct form of nerve stimulation can eliminate the debilitating tremors associated with Parkinson's disease. Zelma Kiss, a brain surgeon at the University of Calgary, has spent the past few years inserting a small electronic transmitter in the brains of people with this problem, looking for the surgical sites and transmission frequencies that yield the best results. Afterward, individuals simply stop trembling with the flip of a switch.

“Today more than 30,000 patients have had this kind of device implanted, whereas before 1993 there were no good surgical options for Parkinson’s,” says Kiss. “This technology completely changed the way we treat this illness.”

And she sees even more tantalizing prospects ahead. This spring, Kiss, Mushahwar, and Stein became the team leaders in a five-year, $5-million project supported by the Alberta Heritage Foundation for Medical Research. Their ultimate goal is to develop implantable prosthetic technology that can compensate for the often devastating effects of spinal cord damage. “What we want to do is restore sensory and motor function,” explains Kiss, adding that this is an ambitious, long-term objective that will have to be tackled in stages. “The first thing you have to do is something that is realistic and not too invasive.”

Their work will begin by refining the smart underwear system, which should find a ready and waiting market in a wide range of clinical care settings. Another portion of the work will draw on Kiss’s findings from transmitters inserted into a key portion of brains affected by Parkinson’s. She is already working with engineers on a new implant that would take advantage of functions controlled by this same brain structure, in particular our ability to sense (or perceive) the body’s balance and posture.

“If you take somebody who has an injury to the sensory part of their nervous system, so they can’t feel where their legs or feet are, they can’t walk, even if their strength or motor function is completely intact,” says Kiss.

And while none of these projects will lead directly to building a Six Million Dollar Man, Kiss expects each of them to yield components that will be part of achieving this ambitious goal. More importantly, while bionic implants should eventually prove to be a boon for anyone suffering from specific challenges like paralysis or lost limbs, each step in developing this technology will help even more people along the way.

“The prospect of a bionic man or woman is exciting,” concludes Kiss. “And what we’re accomplishing right now is just as exciting.”

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