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Revolutionary Prosthetic Limbs: Military Medical Advances

FINDING THE CROSSROADS OF BIOLOGY AND ARTIFICIAL TECHNOLOGY TO REVITALIZE THE HUMAN SPIRIT.

You are listening to ReachMD XM 157, The Channel For Medical Professionals. Welcome to the Strength To Heal brought to you by the United States Army Medical Department, AMEDD. Your host is trauma surgeon Dr. John Armstrong. Dr. Armstrong, a former army colonel, who served as Director of the US Army Trauma Training Center in Miami, Florida, and chair of the ACS Army Committee On Trauma.

Finding the crossroads of biology and artificial technology to revitalize the human spirit. Our guest is colonel and Dr. Geoffrey Ling, neuro-critical care specialist and program manager at DARPA.

DR. JOHN ARMSTRONG:

Welcome Dr. Ling.

DR. GEOFFREY LING:

Thank you Dr. Armstrong.

DR. JOHN ARMSTRONG:

Dr. Ling, you are privileged to serve as a project manager at DARPA. What is DARPA and what is your role as a project manager?

DR. GEOFFREY LING:

DARPA is the Defense Advanced Research Projects Agency. It is an agency that was started in the late 1950s in response to Sputnik and the charge of DARPA is very simple, it is to conduct and support research that will maintain the United States Technical Superiority. So, at DARPA, our job is, in essence, to see what the extreme edge of scientific and engineering knowledge is and then to leverage that into pushing that envelope even further up. So, the project manager or program managers we call at DARPA. Our job is actually to invent programs to do just that. Our job is to find out where the leading edge of science is, no matter where it may be physics, math, biology, medicine, and then to go ahead and see how we can push back that frontier even further so as to improve the capabilities and

the survival of our young men and women who are out on the front lines doing the hard job.

DR. JOHN ARMSTRONG:

So, what are the some of the contributions from DARPA been that might be affecting our lives today?

DR. GEOFFREY LING:

DARPA has a very storied tradition, much of it is in aerospace, but I suppose the greatest contribution that DARPA has made to everybody is the Internet. The original Internet came about as an idea of having Defense Department computers talking to each other and at that time, it was actually known as the ARPANET or the Advanced Research Projects Agency Network. So, the ARPANET fact was the very first iteration of what is now known as the Internet. Other major accomplishments are night optical vision goggles, titanium steel, unmanned aerial vehicles, the M16 rifle, and for you, Dr. Armstrong, a trauma surgeon, the fast scan ultrasound, handheld ultrasound was actually a DARPA project as well.

DR. JOHN ARMSTRONG:

I was going to say you had me at ARPANET. That is a pretty impressive product line coming out of DARPA. Well, I know, that you are the program manager for a variety of projects and one in particular that is thrilling and that has to do with the revolutionary prosthetic arms. What is that all about?

DR. GEOFFREY LING:

Well, it comes out of the need and the need is to basically respond to the injuries that we are seeing in the current global war on terrorism. The lot of young men and women, as you know on the front-line are getting hurt, the good news is because of advance in body armor and advance in medical care, their survival rate is unparalleled, just absolutely unparalleled. So, now we can, as physicians, we are able to turn our attention now towards not just survival, but also restoring their lives, giving them back function, and so one of the most debilitating injuries that you can get is of course loss of your arm and hands because that is the tool by which we interact with the world. The prosthetic legs are much more simple devices because that you'll have to stand and run and walk with those, those are very good, the ones that we have now, and soldiers and you know airmen can return to duty with the prosthetic limbs that are currently available. <____> can go back to airborne duty, go back to flying airplanes. We want to do the same with some who have lost their arms and their hands and that is much more daunting task because as you know when you look at your own hand, how complex that is and there is really no bit of machinery that is available right now that can do what your hands do for you in terms of been able to pick things up, manipulate the environment, play the piano, make music, that sort of thing. You look at your hand; it really is a remarkable device. So, that is the goal of the revolutionizing prosthesis program as to restore hands and arms of those who have lost them to the point where if they want to, they could return to full active duty.

DR. JOHN ARMSTRONG:

Well, that is an impressive goal. To help your listeners understand where this is going, what is the current status of prosthetic arms?

DR. GEOFFREY LING:

The best arm that you can get in terms of functionality is a hook and if you are very lucky, you will get a hook that can open and close and that is it. That is the very, very best internal device or prosthetic hand that is currently available, a hook and only half the patients want that, the other half are content to have a rubber non-functional hand because it is much more cosmetically acceptable than the hook. So, the functional that is provided is really just not satisfactory at all.

DR. JOHN ARMSTRONG:

And given that lets talk about what is happening now, thanks to your work through DARPA with this modular mechanical arm.

DR. GEOFFREY LING:

Well, we set out to start this program over 2 years ago, we actually have created 2 parallel programs, the synergistic, but they have different goals. One is a 2-year effort; one is a 4-year effort. In the 2-year effort, was developed a mechanical arm that was far, far superior than was currently available. So, as I told you, that all we have the hook at the end of, may be, an elbow that will bend and that is it. There is no shoulder, just a bendable elbow on a hook that will open and close. We wanted to go way beyond that. We wanted you to be able to provide the patients a shoulder that is powered if they should need it, an elbow that is powered if they should need it, a wrist that is powered if they should need it, and a 5-fingered hand because at the of the day, the functionality that we think about was with her upper extremity is centered around a 5-fingered hand as we wanted a 5-fingered hand to do the grips that we will use for to do our activities of daily living. So, we wanted at the end of 2-years to have such an arm ready for patients to use that is we wanted. However, the strategy to control that arm would be what we call noninvasive that which required no surgery whatsoever. A soldier, wounded soldier would simply as we like to call, strap and go, in another ways, you just strap it on and then you would just go. The control of that would be local control, some intuitive control and some switches that to be active with the foot or the other arm. The 4-year arm is really a bold thrust into really what you and I will call the 21st century, is now getting a prosthetic arm that will be directly controlled by the patient's intent that is through their nervous system. The same way you and I control our arms through our brain, our spinal cord, and our nerves, that in fact we would use strategy just like that to provide us with a hand that will respond the patient's own will, their own thoughts and so what would that do, that would dramatically increase the functionality of that hand. When <____> plays the piano, he is not conscious he is thinking about moving his fingers up and down, he is playing notes and that is the point. We want to change it, the paradigm from opening and closing the hand, flexing and extending the wrist to actually doing the function the way you and I move arm, but to do that, we will have to tap into the incredible control capabilities, really of the patient's brain and that is what the 4-year project is centered around. So, 2 parallel projects, but 2 obviously very different approaches.

If you are just tuning in, you are listening to the Strength To Heal brought to you by the United States Army on ReachMD XM157, The Channel For Medical Professionals. I am your host, Dr. John Armstrong and our guest is colonel and Dr. Geoffrey Ling. We are discussing revolutionary prosthetic arms.

DR. JOHN ARMSTRONG:

Dr. Ling what are some of the particulars with regard to the neurally controlled prosthesis? How does such a prosthesis interface with the brain and with the limb?

DR. GEOFFREY LING:

Well, the way that you would do that is <____>

INCOMPLETE DICTATION