Developing World Prosthetics

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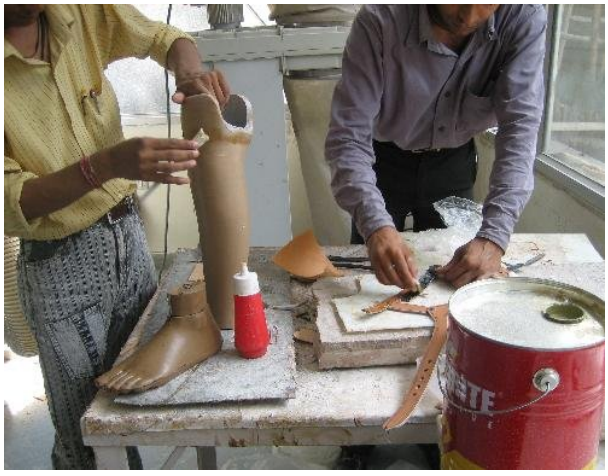
Developing World Prosthetics (DWP) is a non-profit organization dedicated to the design and deployment of prosthetic limbs, orthotic braces, mobility aids, and fitment devices for patients in developing nations. In collaboration with the Indian non-profit Jaipur Foot Organization (JFO), which has fit over 250,000 lower-limb prosthetics, and other multinational rehabilitation organizations, we are increasing the number and quality of low-cost, specialized mobility devices that are specifically designed to maximize patient throughput. As an MIT spinoff organization, we hope to use our strong connection with the institute and its engineering students, classes, and facilities as a means of deploying appropriate medical technologies.

Our Origins as Vac-Cast Prosthetics

In the spring semester of 2007, Vac-Cast prosthetics, a team of MIT students and future founders of DWP developed a low-cost, portable, human-powered vacuum device that enabled the JFO to implement a highly-sought rapid prosthetic fitment technique in rural fitment camps through Indochina.



Orthotics/prosthetics students manufacture a leg given to a patient fit by the JFO at a clinic in Jaipur.

The JFO offers a free prosthetic fitting and forming service through 16 urban centers across India and dozens of mobile fitment camps that reach out to particularly remote villages or crisis areas. Though the mobile camps are the only recourse for those patients who are unable to reach urban medical centers, tight operating costs and limited resources constrict camp deployment to no more than three weeks at a time. In order to reduce the material costs and to increase the patient throughput of mobile camps in rural areas, the JFO and the Center for International Rehabilitation (CIR) in Chicago co-developed a rapid prosthetic fitting process that utilizes renewable material resources and advanced cast-forming technology. Despite granting a cost reduction in fitting materials, the new high-throughput prosthetic fitting technology also requires the use of an air compressor and subsequently introduces the greater cost of renting, fueling, and maintaining and electric generator used to power the air compressor. Vac-Cast improved upon the rapid prosthetics forming technology by inventing a human-powered vacuum pump that eliminated the need for an electric generator in mobile fitment camps that sought to employ the rapid fitting process.

Team Vac-Cast is awarded the Lemelson-MIT prize at the IDEAS competition.

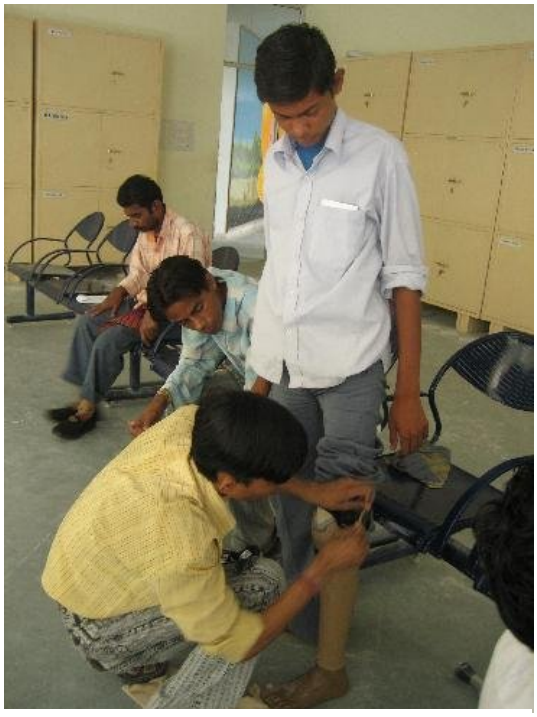
Team Vac-Cast included four MIT undergraduate students and one PhD student

from the Mechanical Engineering Department, as well as a former MIT student from the Electrical Engineering department. In early May of 2007, our team won the Lemelson-MIT award at the IDEAS competition. Part of the funds from the award were invested in creating further generations of a primary prototype of the Vac-Cast system.

Work in India, 2007

In August of 2007, three members of the Vac-Cast Prosthetics team traveled to Delhi and Jaipur, where two of the JFO's biggest urban fitment centers are located. We received feedback and further design parameters for the Vac-Cast vacuum system, learned about the fitment process, and generated new project ideas to improve the patient care the organization provides. We demonstrated the device both for practicing orthotists/prosthetists (O&Ps), and for JFO representatives who work primarily on research and development.

Members of both DWP and the JFO demonstrate the first prototype of the Vac-Cast system.



After spending the day in a clinic, a patient wears his free, custom-made prosthetic limb.

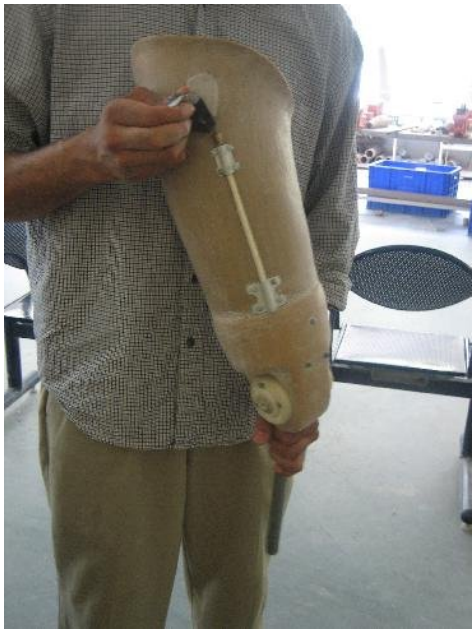
Through our time working at the clinics with patients, doctors, researchers, and students, we learned about patient care, the available manufacturing materials, and JFO's resource and time constraints. This experience revealed not only the problems with our Vac-Cast system, but those of other devices and techniques the JFO uses. Due to time constraints and the great number of patients that must be seen every day, most of the O&Ps do not have time to improve on technologies for better treatment of their patients. On the other hand, due to their extensive first-hand experience, they have the clearest view of how patient care is hindered, and where improvements are most necessary. The representatives with whom we collaborated were enthusiastic about the Vac-Cast device as well as our interests and intentions in helping them make further improvements to their fitment technologies.

We extended offers to assist the JFO in developing technology and improving their devices to help them administer the best patient care. As a result, we spent some time thinking of project ideas and devising potential process improvements. We left India having established strong personal and professional connections. These ties provide an exciting opportunity for MIT to work with

the JFO to be on the cutting edge in devising medical care solutions that both improve quality of life for millions of people and respect the limited resources available in the developing world.

Future Projects

The JFO focuses on patient care, but its intimate knowledge of both the available resources and the needs of the patients makes it best suited to develop project ideas that would be most helpful in the realm of mobility aids for the developing world. We returned from India with a list of needs that O&Ps at the JFO want to address and potential products for MIT students to engineer. This list includes perfecting the sandcasting system that is currently under trial and that we began to modify for use in rural areas, as well as improving mobility devices themselves. For example, the JFO wants to improve orthotic knees for polio patients and to create stance-control orthotic and prosthetic knees for above-knee amputees. Current low-cost technologies do not allow patients to bend their knees for a normal gait. Instead, above-knee amputees walk with a straight-legged gait and activate a mechanism that allows them to bend the knee when they want to sit. It is imperative that we further mobilize these patients, while increasing comfort and maintaining normal muscle control. This is a problem we hope to tackle with a rehabilitative devices seminar planned for the spring of 2008 at MIT.



Current prosthetic knee technology does not allow a normal gait or normal muscle control.

Rehabilitation Class at MIT

We are working to establish an MIT class focused on rehabilitation and rehabilitative devices for the spring of 2008 to engage the collective energies of MIT students. We have already spoken to many noted individuals in the rehabilitative field who would be willing to guest lecture, including Dr. Hugh Herr of the MIT Media Lab, Dr. Yeongchen Wu of the CIR, Dr. Bob Emerson, a private O&P from the Boston area, and Mr. Sanjeev Kumar, one of our primary contacts from the JFO in Delhi. The aim of the class is twofold: to provide a broad knowledge base about rehabilitation and to apply this knowledge to the completion of a project. We would like to educate students about devices on the forefront of prosthetic technology and on the mass-manufactured devices used for the majority of patients in the developing world. We would also like to teach students about the biomechanics of walking to contextualize the technology they will learn about. The second goal of the class is for the students to complete some of the projects that the JFO does not have the resources to work on, as previously outlined. We hope that this class becomes a permanent fixture at MIT to continue helping the JFO and other partner organizations, to continue promoting service learning at MIT, and to strengthen MIT's impact on the developing world.