Survivor Assistance through Technology Transfer in Tanzania

This article describes how cutting-edge technology is being developed and disseminated in landmine-affected countries. Focusing particularly on the Tanzania Training Center for Orthopedic Technologists, the authors examine how a process of appropriate, resource-effective casting is being advanced and then shared through training workshops. Improved technology and its successful transfer are vital to better assisting landmine survivors, a goal the Center for International Rehabilitation is working to achieve.

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Dr. Yeongchi Wu, inventor of the CIR Transtibial Prosthetic Casting System, demonstrates how clay can be applied to a positive plaster model to create a pressure relief in the final socket.

Although Tanzania does not have a significant landmine problem, the nation serves as home to the most recognized prosthetic and orthotic training institution in Africa. The Tanzania Training Center for Orthopedic Technologists (TATCOT) trains practitioners from all parts of Africa, who are then able to provide prosthetic and orthotic services to survivors of landmine and other war-related injuries in their home countries. Based in Moshi, Tanzania, TATCOT is currently the only training center in the developing world that has received Category I certification[1] from the International Society for Prosthetics and Orthotics.

To disseminate innovations in prosthetic technology to landmine-afflicted nations, the Center for International Rehabilitation has been conducting a series of hands-on training workshops in training centers and rehabilitation clinics around the world. In collaboration with TATCOT, the CIR organized and implemented a one-week workshop to train professionals in the use of the CIR Transtibial Prosthetic Casting System in June 2004. The objective of the workshop was to transfer the knowledge developed at the CIR to faculty and students in order to improve the quality of care available to landmine survivors throughout Africa.

The casting system, developed by CIR Research Director Yeongchi Wu, M.D., provides an appropriate, resource-effective solution for prosthetic socket fabrication. The system uses local materials to fabricate a prosthetic socket and artificial limb in less than one hour. As a result, a landmine survivor can visit a clinic and leave with a custom-made prosthesis in a matter of hours. The success of prosthetic service provision and training in landmine-affected areas depends largely on the technology used and the degree to which it fits with the local environment.

Appropriate Prosthetic Technology

It has been well-established that high-tech Western prosthetic technologies are not always suitable for developing countries. The International Society for Prosthetics and Orthotics stressed the use of appropriate technology at its Consensus Conferences in Cambodia[2] and Tanzania,[3] defining appropriate technology as "a system providing proper fit and alignment based on sound biomechanical principles [that] suit the needs of the individual and can be sustained by the country at the most economical and affordable price."[2] There are a significant number of efforts underway to develop appropriate prosthetic technologies for landmine-affected countries; however, many have been designed and produced without accounting for key factors such as the environment, local resources and culture.

Furthermore, many new technologies continue to rely on older methods and resources that still require a fully operational prosthetic clinic. It is necessary to develop new products and fabrication methods that do

not rely heavily on electricity, which can be unstable in war-torn countries. These products and methods must also be portable to rural communities in order to provide services to the many amputees who cannot afford to commute into urban areas to obtain a prosthesis.

In response to the continued need for appropriate technologies, the CIR operates a Rehabilitation Engineering Research Center[4] on Improved Technology Access for Landmine Survivors. Funded by the U.S. Department of Education's National Institute on Disability and Rehabilitation Research,[5] the RERC carries out research and development, education and training, and technical-assistance activities. Much of the RERC's work has focused on the development of assistive technology and prosthetic solutions for landmine survivors. RERC products and methods are designed for global applications; although researchers must work with limited resources, the new technology still adheres to the high biomechanical standards for rehabilitation services.

The RERC has also developed multilingual training modules for use in its technology transfer workshops and the CIR's distance-education program. Throughout all landmine-affected countries and the developing world in general, there are not enough qualified prosthetists to serve the amputee population adequately; greater numbers of technicians must be trained in order to meet the need for prosthetic service. One of the RERC's goals is to help meet this need by providing educational materials and workshops to improve training opportunities for students and professionals in the targeted areas.

Development of the CIR Casting Technology

Along with the need for more training, another barrier to increasing prosthetic service delivery is the time-consuming customization process of the prosthetic socket. In many parts of the world, traditional prosthetic techniques using plaster of Paris are still being used for the fabrication of sockets. Traditional casting and socket fabrication methods require the prosthetist to cast the patient on the first visit, using a plaster bandage to obtain a negative mold of the residual limb. The plaster is then poured into the negative mold to produce a positive model, which is then modified by the prosthetic technician. Finally, the socket is fabricated over the positive model. The entire process can take up to two days. These techniques require multiple visits between the patient and prosthetist, as well as non-reusable imported resources that are costly in many developing countries.

The CIR Transtibial Prosthetic Casting System, which has been the focus of many CIR workshops, exemplifies how appropriate technology can be used to maximize time, money and resources at rehabilitation clinics. Using vacuum power and sand in place of plaster, the system produces a positive model of the residual limb of a transtibial (below-knee) amputee for prosthetic socket fabrication in less than one minute. The practitioner can modify the positive model immediately in preparation for the formation of the customized prosthetic socket. The system drastically reduces the amount of labor and time previously needed for the prosthetic fabrication process; it also utilizes recyclable sand, lowering material costs.

An amputee tests out the CIR Transtibial Prosthetic Casting System at the CIR training workshop at the Tanzania Training Center for Orthopedic Technologists.

Technology Transfer: Training In Action

As the main regional prosthetic and orthotic training center for eastern Africa, TATCOT offers a Bachelor of Science in prosthetics and orthotics, as well as one- to three-year diploma and certificate programs in prosthetics and orthotics and a one-year course for wheelchair technologists. According to the United States Agency for International Development, graduates of TATCOT are currently employed in more than 19 countries.[6] Additionally, the International Committee of the Red Cross created a program with the Tanzanian government that includes the provision of prostheses for up to 50 amputees each year.[7]

The CIR's training approach involves direct, hands-on interaction among the workshop leaders and practitioners in attendance. By traveling directly to TATCOT, CIR's experts were able to explain the casting technology and gain a better understanding of TATCOT's resources and needs. The school's objective of providing improved training and increasing the number of orthopedic practitioners in Africa[8] aligned well with the CIR's goals for distributing its technology throughout the parts of the world affected by landmines.

Twenty-four participants from TATCOT and centers throughout Tanzania attended the training workshop. Handicap Inter-national sent one of its field managers, also a trained orthopedic technologist, from Sierra Leone to participate in the workshop. Led by Dr. Wu, the training covered a review of existing technologies, a demonstration of the system and intensive work with patients. Participants were divided into small groups to work on patient evaluation, casting and socket forming.

During the second half of the workshop, the participants learned about proper prosthetic alignment and assembly and evaluated the gait of the patients they had served. The workshop concluded with an open discussion about the system and its applications in the clinical setting. Participants had the opportunity to exchange information, share their experiences and gain new methodologies for the treatment of landmine survivors.

Future Progress

Through post-workshop reports from TATCOT, the CIR learned that the participants continue to use the system periodically. TATCOT Director and International Society for Prosthetics and Orthotics Resident Harold Shangali has been working to further develop the system to accommodate transfemoral (above-knee) amputees as well. With the technology successfully transferred, follow-up communication between the CIR and TATCOT is ongoing. Researchers at the RERC are developing new generations of the system for further testing and distribution worldwide.

In addition, the RERC has been working on other research and development related to assistive technology. These projects include a prosthetic socket fabrication system, a wheelchair designed for use in rugged environments, a prosthetic alignment measurement system and development of new prosthetic foot designs. Testing for the projects has been carried out in field locations including Nicaragua, El Salvador, Vietnam and Afghanistan.

To continue to foster communication among rehabilitation centers and create opportunities for new partnerships with organizations serving landmine survivors, the CIR has created a network of 20 centers worldwide to disseminate its technologies and training materials. Through the network, each partner organization serves as an extension of the CIR by way of its work in landmine-affected countries and other developing regions of the world. Potential endeavors in the future include additional collaborations with TATCOT and other rehabilitation centers and organizations in Africa. The CIR continues to make efforts to work with international agencies to find new ways to address the issues of effective survivor assistance in Africa and worldwide.

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News Brief

Earth-friendly Explosives?

Researchers in the United States report they have developed "green" chemicals that can serve as a viable replacement for lead-based materials used as primary explosives to detonate all types of explosives. Primary explosives ignite powerful secondary explosions and are, while relatively weak, very sensitive. More problematic, according to recent studies, are toxic plumes released when lead-based explosives are fired.

Chemists have long struggled with finding safe chemicals to replace primary lead-based explosives because of a need for a proper balance between stability and sensitivity. One of the major obstacles to developing a suitable replacement has been that the new chemicals lose sensitivity when wet.

Currently the chemicals used to make traditional lead-based primary explosives involve high levels of risk; therefore, most manufacturers opt to import those components. The new "green" chemicals, however, are not active until dried, and can be stored indefinitely in their wet form. The use of "green" chemicals could lead to safer and more controlled production, make explosives less sensitive, while also eliminating collateral toxic plumes.