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Mohammad Ismail

Project Hope Sudan

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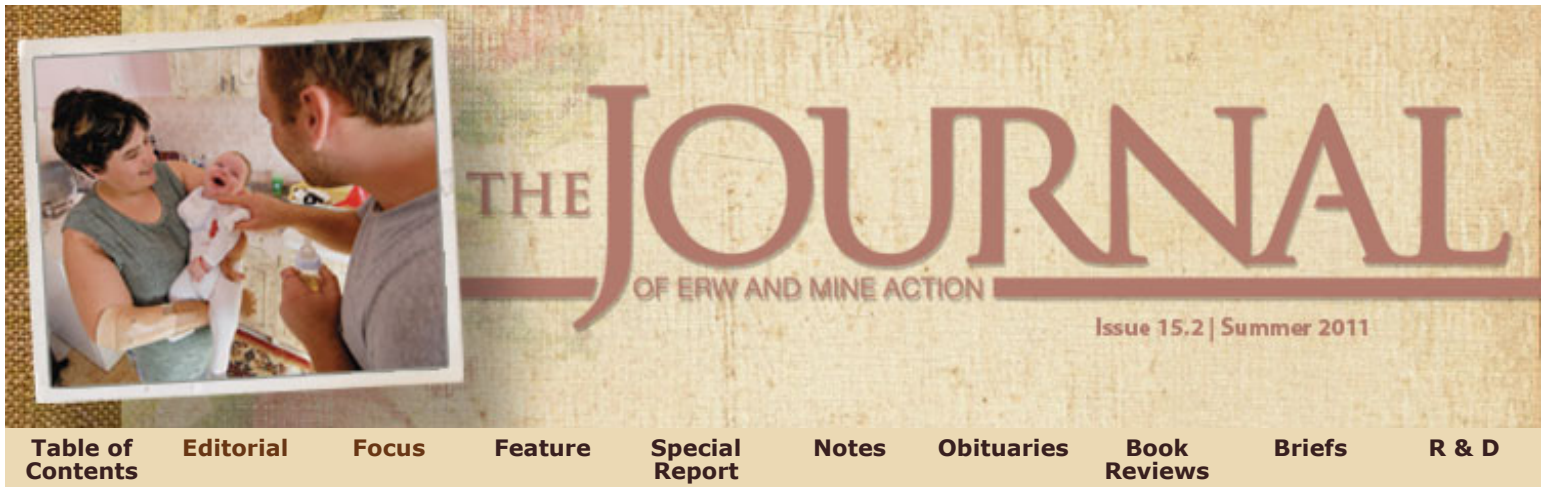


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New Prosthetics Offer Hope in Sudan

by **Mohammad Ismail [Project Hope Sudan]**

Unfortunately for amputees in developing countries, poverty and disability go hand-in-hand. Limb loss can make it extremely difficult for victims to provide for themselves and their families. From this reality came the inspiration for Sudanpro, an inexpensive and durable prosthetic developed by the author, an orthotist and prosthetist working with Project Hope Sudan.

In many developing countries, orthotic and prosthetic practitioners are without the resources to meet amputees' needs. According to many estimates, there are around 60 million amputees. Often the high cost of prosthetics and the intense labor required to produce these devices limits organizations in the number of people they can serve. A lack of resources availability further hinders efforts in the field, as Western prosthetics often require materials unavailable in developing countries. Available resources are also often too costly for wide distribution.



The total cost of the SACH foot per leg is less than US\$100. More than 1,400 people have been fitted with this kind of prosthesis. All photos courtesy of the author.

Training personnel to manufacture, fit and adjust prosthetics is an expensive and time-consuming process, and many organizations in the developing world cannot afford to expand their staff or their area of operation. In addition, the time and effort required to conduct a fitting is great, which reduces the amount of assistance the limited number of trained practitioners can provide to amputees. Consequently, many service providers are unable to meet the high demand for prosthetics.

Sudanpro: A New Approach to Prosthetics

First conceived in 1995, the Sudanpro prosthetic leg was designed to alleviate some of the issues associated with prosthetic-limb provision. Using lighter, lower-cost and readily available materials, the Sudanpro prosthetic leg allows for faster fitting, casting and training at a lower cost. The Sudanpro prosthetic leg has not yet been copyrighted. Hope Sudan manufactures, fits and services the

Sudanpro prosthetics. For less than US\$150, it can give an amputee a new leg and subsequently new opportunities to move, work and thrive in their community.¹ Without the high manufacturing and materials cost, organizations are free to expand their staff and provide service to more amputees.

Sudanpro technology also offers opportunities for organizations using Sudanpro technology to service more remote regions, where access to prosthetics may be limited. Unlike other prosthetics in use, casting and fitting of the Sudanpro mold requires no special equipment, and enables practitioners to conduct fittings in more isolated areas.

Materials. Often the West conceives and designs prosthetics, and then the technology is transferred to the developing world. The problem with this situation is that many of the materials available to Western prosthetists are scarce and expensive in the developing world. Sudanpro technology, however, was engineered with special consideration for the materials actually available to prosthetists in the field.

One such material, central to the design of Sudanpro, is polypropylene, which is a plastic used in a variety of contexts, such as food packaging, plastic hinges and rods, textiles, and automotive components. Because of its extensive use, polypropylene can be found throughout the developing world, including in Sudan, where it takes the form of PP rods. The physical properties of polypropylene plastic make it ideal for use in prosthetics, as it is tough yet flexible and has a high melting point, making it resistant to warping in heat.

Sudanpro also uses a copolymer pylon, which contains 20 percent polyethylene. Polyethylene increases the working life of the prosthesis, allowing for flexibility in the pylon. This flexibility is crucial for the patient's mobility because it allows the patient to retain energy during the stance phase and release it in the swing phase of their stride. In a recent study, researchers concluded that pylon flexibility in prosthetics allows patients quicker, more comfortable strides.²

Because of this increased flexibility in the leg's shaft, Sudanpro does not require the expensive Flex foot used in other prosthetics to achieve the same flexibility. Instead, Sudanpro replaces the Flex foot with a much cheaper SACH foot, manufactured by the Chinese government.



The SACH foot looks like a real foot, is less expensive than the Flex foot and is easy to fit and use.

Depending on taxes, price fluctuations and the facility's location, the materials necessary to produce a Sudanpro prosthetic leg cost anywhere from US\$50 to US\$100. In many cases, the materials are exempt from import taxes, allowing the cost of materials to be less than US\$100.

Production. The production of a Sudanpro prosthetic limb can begin as soon as the amputee is healthy enough for evaluation. Prosthetists analyze the stump and develop a plan for the prosthetic's construction and alignment. This initial alignment plan saves production time because, having already sketched the alignment, the prosthetists do not have to conduct extensive trials in the fitting's last stage. The development of a plan early in the process also allows for a better fit, because prosthetists can manufacture the leg from the beginning with the final alignment in mind.

The leg has fewer parts than commonly used in prosthetics, which reduces joint stress and increases the prosthetic's weight

tolerance, making Sudanpro a more durable prosthetic. Having fewer parts also reduces the overall weight of the prosthesis by about 30 percent. Taking into consideration lost momentum, this decreased weight saves patients energy in their strides.



The SACH foot easily fits in a shoe.

Although the casting process requires a well-trained practitioner to properly anticipate the weight distribution lines, it does not require any specialized equipment and can be as efficient as double practitioners' efficiency. Casting only requires power and a flat-bed oven with an even distribution of heat capable of reaching 300 degrees Celsius (570 degrees Fahrenheit). Within three to four hours, a prosthesis can be cast, aligned and fitted for a patient, and within six hours, the patient can begin training with the new leg.

Because the process requires no specialized equipment, practitioners can also conduct fittings in the field. Sudanpro prosthetists can cast a new leg anywhere with an oven and electricity. This is an important advantage, as they normally would be unable to cast limbs outside of their facility. If implemented properly, this mobility allows organizations to expand their

operations to previously unreachable areas.

Results

Sudanpro technology has the potential to help victims and the organizations assisting them, giving new vitality to the prosthetics field. Since 2006 when it was first implemented, Sudanpro technology has fitted 678 amputees with 682 prostheses, at very low costs. Victims who previously could not afford more expensive prostheses were given renewed hope that they, too, can comfortably stand, walk and run with the help of Sudanpro technology. In the future, Sudanpro's makers hope to extend the technology to other countries where victims are without access to inexpensive prostheses. Organizations working in Brazil, Ecuador, Egypt, India, Kenya, Liberia, Nigeria, Pakistan and South Sudan are exploring the technology, but even with the help of these organizations, millions will remain without access to prosthetics. However, with further interest and effort, Sudanpro technology will someday reach these victims, and grant them the freedom of mobility. ↗

CISR staff member Jeremiah Smith assisted in the research and writing of this article.

À Biography



Mohammad Ismail is the ortho-prosthetist who designed the Sudanpro technology and has headed Project Hope Sudan since April 2005. He is pursuing a master's degree in advanced studies in humanitarian logistics and management at the University of Lugano, Switzerland USI (*Univesita della Svizzera Italiana*), and expects to graduate in October 2011.

Mohammad Ismail
Ortho-prosthetist/Manager
Project Hope Sudan
Tawsol Al Amal Charity Organization
Building #3, Hope Medical City
Jabal Awlayia, Khartoum State / Sudan
Tel: +00249 91 82 38 104
E-mail: mshlash2002(at)yahoo.com

Endnotes

1. Coleman, K.L., D.A. Boone, D.G. Smith and J.M. Czerneki. "Effect of trans-tibial prosthesis pylon flexibility on ground reaction forces during gait." *Prosthetics and Orthotics International*, Vol. 25: 195-201 (2001). <http://poi.sagepub.com/content/25/3/195.abstract>. Accessed 9 February 2011.
2. Mohammad Ismail runs Project Hope Sudan. The Project is funded by several providers: the government of Sudan, the State of Khartoum government, private donors and the beneficiaries. It employs about 120 people. They offer state-of-the-art service in limb fitting.

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