



Research and Studies

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Pilot Testing of 3D Printing Technology for Transtibial Prosthesis in Complex Contexts (Togo, Madagascar and Syria)

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About this brief

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Operational and Technical Resources Division



“Handicap International is an independent and impartial international aid organisation working in situations of poverty and exclusion, conflict and disaster. We work alongside people with disabilities and vulnerable populations, taking action and bearing witness in order to respond to their essential needs, improve their living conditions and promote respect for their dignity and fundamental rights.”

About this study

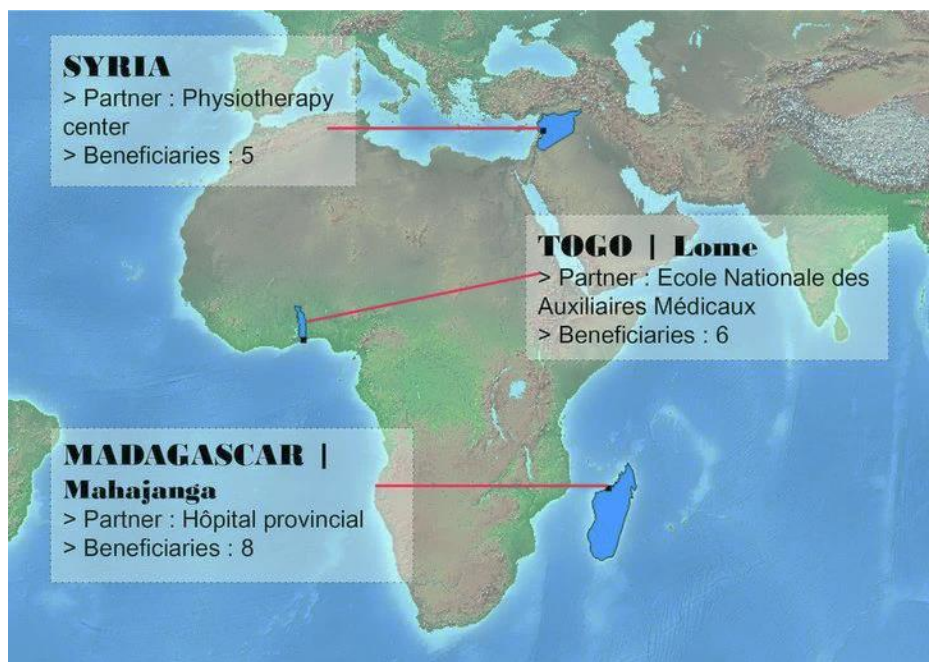
This study has been conducted with the support of:



A. Innovation in physical rehabilitation within complex contexts

The development of new technologies such as Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) System, 3D printing in biosciences, Information and Communication Technologies (ICT), and telemedicine, has opened ground-breaking approaches for providing health services. However, those **new technologies are not accessible to low-income countries or in war and emergency contexts.**

Innovation is part of Handicap International’s 10-year strategy (2016-2025). The organisation is involved in physical rehabilitation within complex contexts. In **January-October 2016**, Handicap International carried out a pilot testing of 3D printing technology for transtibial prosthesis in Togo, Madagascar and Syria.



In war-torn Syria, the security situation prevents Handicap International from carrying out operations in situ. Prostheses are therefore delivered from neighbouring countries. Local partners have to deal with rudimentary and temporary facilities due to the volatile situation, complicated logistics, as well as a lack of qualified human resources to provide a full range of rehabilitation services. While in Togo and Madagascar, these developing countries lack decentralised services and qualified human resources to meet the need for physical rehabilitation, but they also face challenges in having access to appropriate technologies.

B. Methodology

The project brought together a full team of experts, including rehabilitation clinicians, academics and industrials. In partnership with the **University of Strathclyde** and two industrial companies - **ProFit Technologies** and **Proteor SAS** - Handicap International conducted a study which aimed at establishing new intervention methods in the field of physical rehabilitation:

- ProFit, an international company based in Bulgaria, was in charge of the technical aspects for the entire socket design and 3D printing process, from measurement to manufacturing;
- Proteor SAS, a French company was in charge of the provision of the necessary components;
- University of Strathclyde (Scotland, UK), via its Biomechanical Engineering Department, was responsible for the methodological oversight of the study.

The study protocol entailed comparing the fitting of patients with conventional vs. 3D printed transtibial prostheses.

19 volunteers (6 in Togo, 8 in Madagascar, 5 in Syria) were selected by the local partners according to the following criteria: healthy adult volunteers with a transtibial amputation, a stabilised residual limb, and a prosthesis that was fitted at least within the past two years.



The patients were randomly assigned to one of two groups:

- **Test group:** patients receiving a 3D printed socket;
- **Control group:** patients receiving a socket manufactured by the local partner.

Both the test and the control groups were fitted with a silicone liner.

Those processes should allow:

- The **delocalisation of competencies** outside the zones of conflict or the zones which are hardly accessible;
- The **delocalisation of the orthopaedic devices production infrastructures** outside the difficult areas;
- The **simplification of the logistic processes** by sending manufactured items instead of raw materials.

Key rehabilitation actors were involved in the project:

- A school for rehabilitation professionals (*Ecole Nationale des Auxiliaires Médicaux*) in Lome, capital city of Togo;
- A decentralised physical rehabilitation service in **Mahajanga Provincial Hospital, Madagascar**;
- A **physiotherapy centre** in a conflict zone in Syria (location undisclosed due to security concerns).

Three components were evaluated:

1. **Clinical:** New process in conformity with the rules of clinical protocols; improvement of performance and comfort; standardized tests (TUG, SCS);
2. **Technological:** 3D socket compatibility with the mechanic and adaptability requirements (ISO tests);
3. **Organisational:** Benefits in terms of relevancy with patients' expectations and needs, costs, logistic, infrastructures and equipment.



C. The findings of the study

Main findings:

- 1. Clinical:** The new protocol respects clinical rules. Patients' participation is improved during the process. Remote treatment is available. However, the number of test subjects is still insufficient to be conclusive.
- 2. Technological:** The technology conforms to resistance and endurance standards.
- 3. Organisational:** The process reaches patients in remote areas or conflict zones. It reduces the infrastructures, equipment and human resources needed. However, direct costs are still too expensive for low-income African countries. For Syria, the direct costs are nearly the same as the prices currently charged in the country.

D. Conclusion & Perspectives

There is a necessity to develop new projects aiming to:

- Increase the number of trials;
- Reduce the costs of soft liner, components, printers through further research;
- Include other contexts of intervention;
- Enlarge the range of orthopaedic devices: orthoses, upper limb, etc.



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For further details:

http://www.hiproweb.org/uploads/tx_hidrtdocs/Rehab_3D_RS05_ScientificSummary.pdf

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