Researcher develops upper limb orthosis with 3D printing

The model would be cheaper and more functional than the current ones, but it hasn't hit the market yet

Report: Nathália Cassola

The creation process involved designers, users and occupational therapists - Photo: media use

The orthoses have the function to assist limb positioning and increase mobility of users, they are indicated in cases of accident or diseases of the locomotor system. Differently from the immobilizing characteristic of the plaster, the orthosis is adjusted according to the patient necessities and should be as much aesthetically as functionally enjoyable. By keeping the limb in the right position, they promote the rehabilitation and improvement of individuals' quality of life, as well as give them independence to perform their daily activities. The occupational therapist Kelin Luana Casagranda has developed a method of orthosis making with the aid of digital fabrication and 3D printing techniques by approaching her knowledge of available technologies in a process that involved *designers*, users and occupational therapists. The project, which was part of her master's research conducted in the Graduate Program in *Design* in UFRGS, also promotes the democratization of equipment and technologies, so that its products become more accessible to the population. An alternative to the current models, one that meets the necessity of the patients, was designed in collaboration with professionals from different fields of expertise. "Collaborative design means is the power to team up with people with different backgrounds to create something together, to bring your knowledge and share it with each other. We work for a common good", she says.

During the initial research phase, Casagranda spoke with professionals and orthoses users to establish the requirements needed for the orthosis to be effective. In addition to a good functional performance, the orthoses should be lightweight, easy to put on and take off, and look good aesthetically. It was important that it had a socially acceptable design, as current versions on the market are ugly, uncomfortable, and heavy. According to her, orthoses should not draw attention to avoid creating the stigma of disability for its user. "Many patients don't like to use them because they resemble the medical model," says Casagranda. After talking with those involved, the researcher identified aesthetics and functionality as the main factors to be considered. The sample to be developed should be even more adaptable and cost-effective, focusing on the users' needs and requirements, besides taking into account ergonomic and anatomical factors.

Currently, the orthoses are made of thermoplastic, which is heated and then modeled directly on the patient's limb. The process, besides causing some discomfort, does not fit the limb as well as the 3D printed version. Sometimes, due to lack of knowledge, professionals end up using low cost materials in the production, which compromises both aesthetics and usability of the product. To get an orthosis, the patient goes through different phases. First, there is an assessment to define what type will be required. A conventional model takes two to three hours to be prepared, but if a specific finish is required, it can take up to a week to reach the patient. When it is done by the 3D printer, the process can take a little longer. The limb is scanned, which takes around three minutes. The modeling process in the *software* takes two to three hours if made by someone experienced, with seven more hours of printing. Regarding prices, a thermoplastic orthosis costs about 200 to 300 reais, depending on its characteristics. During the research,

Casagranda says that the consumables for printing her version cost between 8 and 10 reais, but the costs of the *software* and the necessary machine were not calculated.

The orthosis was tested on only one research participant because of the limited time available to expand the tests. The patient already used a neoprene or canvas splint to maintain the correct positioning of his hand and received a new model. The feedback of the orthosis developed by the group was positive, highlighting its lightness, ease of closure and aesthetics. With the user participating in the process, he was allowed to choose the desired color and also pointed out that it was more ventilated, producing less sweat during daily use. Although it had been a small-scale test, Casagranda intends to continue working on the subject, developing further research on both orthoses and 3D printed prostheses. "My goal is to see people who need an orthesis having access to it, there is no use in keeping it only a research," she says. For the occupational therapist, the next step is to make the orthoses available to patients and bring them into the real world. Before marketing it, it has to be employed to other people and other types of cases to optimize the process and generate the best possible outcome.

Thesis

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