

Development of an Adaptable Ankle Joint Cover for Leg Prostheses

Degree programme : BSc in Micro- and Medical Technology | Specialisation : Medical technology
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Leg prostheses support lower limb amputees in daily life activities and must endure many walking cycles. At present, ankle joint covers do not have the elastic properties to resist long-term mechanical cyclic stress. A novel manufacturing process for the ankle of a lower limb prosthesis has been developed using 3D scanning, 3D modelling and 3D printing techniques.

Introduction

Today, the technological development in the field of prosthetics support amputated people in performing movements and functions, giving them a certain level of independence. In the world of orthopaedics, it is possible to obtain shapes very similar to those of the real limbs using soft materials. The latter, however, are not suitable to withstand continuous dynamic deformation. In lower limb prostheses, the mobility of the ankle severely limits the lifespan of the cover, causing a partial or total break after a short period of time.

Goals

The objective of the bachelor's thesis, in collaboration with Botta Orthopädie AG, was to develop a durable and adaptable cover for the ankle of a lower limb prosthesis using modern 3D printing technology. In order to provide psychological relief to the user, it was necessary that the adaptable cover for the ankle of lower limb prostheses has visual and mechanical properties as similar as possible to a real ankle. The size of the cover should be adapted according to the size of the prosthesis.

Methods

The geometry of a prosthesis supplied by Botta Orthopädie AG was carefully digitised with 3D scans

supported by manual measurements. The design was refined using CAD modelling. The materials selected to produce the cover were thermoplastic polyurethane (TPU) and thermoplastic elastomer (TPE). Both polymers are used in 3D printing and have mechanical properties similar to those of the skin and tendons.

Results

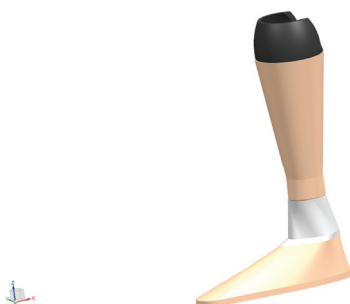
There are two main outcomes of this project. Firstly, a demonstrator of an adaptable and durable ankle cover for lower limb prostheses was developed and printed using 3D technology. Secondly, a 3D model of the ankle, which allows the modification and adaptation of the cover to different types of prosthesis.

Further Steps

In the future, once the piece is printed, the company has the possibility to finish the workpiece using the classic methods of processing in the orthopaedic industry, such as smoothing, polishing, painting and various refinements. With the methods developed, the company has another process for the production of an ankle joint cover. The lifetime of the cover still has to be tested, but thanks to the materials used, an increased lifetime is expected.



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CAD model of the prosthesis. The ankle joint cover for lower limb prosthesis represented in grey.



3D printed ankle cover mounted on the prosthesis supplied by Botta Orthopädie AG.