Project title:	Patient-individualized textile implants through the use of digital process chains
Acronym:	IndiTexPlant
Duration :	12/2019 – 11/2021
Funding agency :	BMWK – IGF-Forschungsvorhaben 20532N

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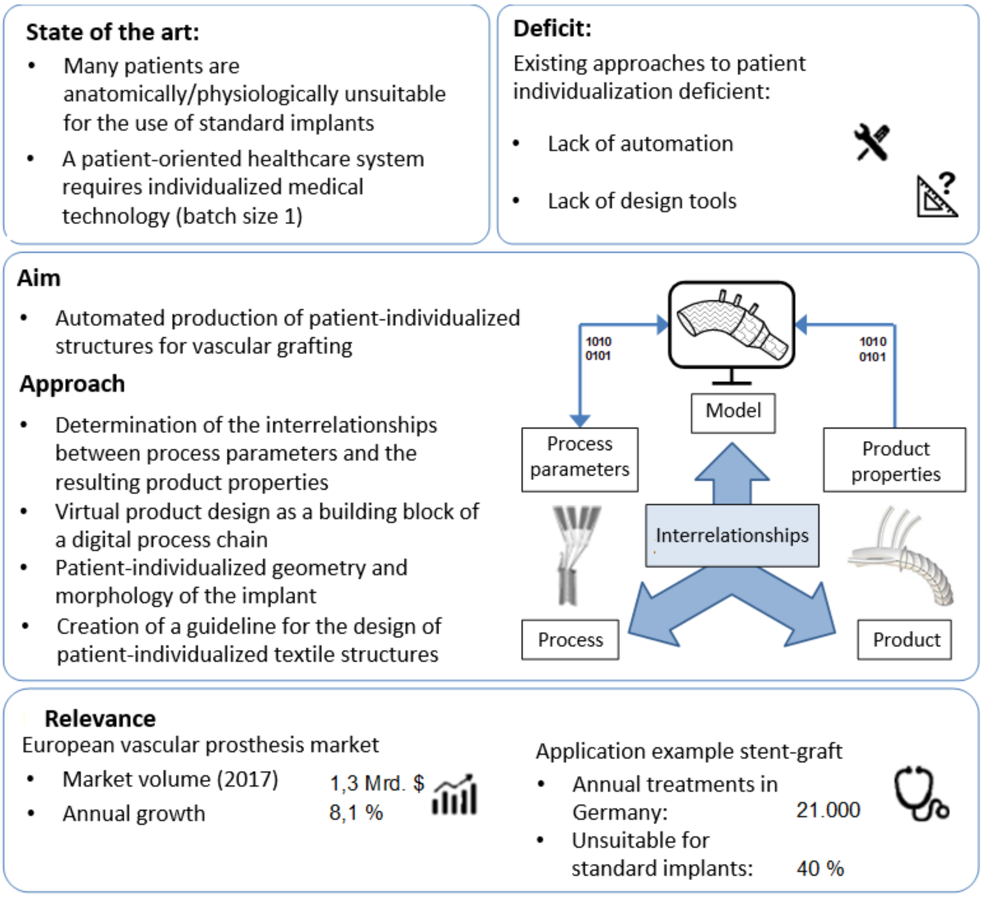
08.04.2022

Mission Statement

Demographic change and increasingly unhealthy lifestyles in the Western world are leading to a steady rise in patient numbers and posing major challenges for modern medicine. The European vascular prosthesis market is already worth €1.3 billion, with annual growth of 8.1%. Patient-oriented healthcare will make the individualization of medicine indispensable in the future. This also requires further progress in patient individualization, particularly through medical technology, in order to achieve the desired therapeutic success. From a technical and economic point of view, this is contrasted by the requirement for economical and reproducible production of products with a batch size of 1. These requirements can be met with innovative textile manufacturing processes. However, there is a lack of a fundamental understanding of product design, final product properties and the intermediate manufacturing processes, as well as appropriate tools for the implementation of these patient-individualized approaches.

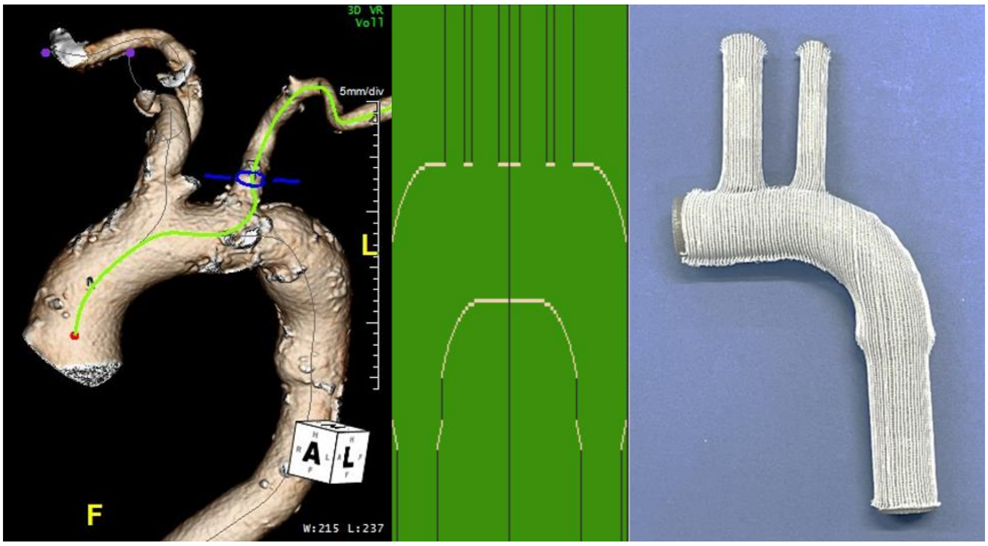
Approach

The objective of the project is therefore to implement an automated manufacturing process for patient-individualized textile implants in order to provide patients with a therapy that is ideally tailored to their needs. To this end, approaches for geometric and morphological patient individualization of textile implant structures using Jacquard knitting technology are being investigated. Implants for the treatment of vascular diseases (e.g. arteriosclerosis, aneurysms) serve as an application example, since this is a clinically as well as economically extremely relevant field of application for patient-individualized implant structures. At the end of the project, a hybrid structure for the treatment of a complex aortic aneurysm in the region of the aortic arch will be selected as a validating application example. With regard to a continuous digital process chain, a virtual product design is used. A decisive factor for the success of the project is the determination and evaluation of the relevant process parameters for the main process "warp knitting". Tools and aids for monitoring the process and inline monitoring of the product quality have to be developed and implemented. Subsequently, the relevant process parameters of the warp knitting machine are digitally read out and analyzed with regard to their influence on the product quality. The aim is to obtain a modular system in which geometric and morphological elements can be combined with each other in the virtual product design to create patient-specific structures. The result is a tailor-made implant for the respective patient. Finally, a guideline for the design of patient-individualized textile structures using Jacquard knitting technology will be developed. With the help of this guideline, a transfer of the generated results and correlations to further applications will be made possible.



Results

Within the scope of this project, different approaches of geometric and structural patient individualization of textile stent grafts on a Jacquard warp-knitting machine were investigated. A suitable lapping pattern of the tubular warp knitted fabric was developed on the basis of the list of requirements and the three individualization elements (diameter change, branch, curvature) for a patient-individualized stent graft were developed. For the continuous digital process chain, a database-supported virtual model for the product design was developed, which enables the transfer of measured CT data of a thoracic aortic aneurysm into a 3D model. The cause-effect relationships between the virtual product design, the process parameters of the manufacturing process, and the resulting implant properties were determined both in-line and off-line. For the inline acquisition of process parameters, in particular, a yarn tension monitoring and an inline video analysis were developed and implemented. These acquired data were fed back into the virtual model database, thus continuously improving the accuracy and robustness of patient-specific design and production of implant structures. In this way, an economical and reproducible production of textile implants with a batch size of 1 could be realized, thus enabling a therapy that is optimally tailored to the patient. Finally, the knowledge gained was used to develop a guideline for the use of digital process chains in the design and production of geometrically and morphologically individualized textile structures.



Acknowledgement

The IGF project 20532 N of the Research Association Forschungskuratorium Textil e.V., Reinhardtstraße 14-16, 10117 Berlin was funded by the Federal Ministry of Economics and Climate Protection via the AiF as part of the program to promote joint industrial research IGF on the basis of a resolution of the German Bundestag.

Gefördert durch:

Bundesministerium
für Wirtschaft
und Klimaschutz

aufgrund eines Beschlusses
des Deutschen Bundestages

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