

Development of a Tibial Tray Implant with Lattice Structure



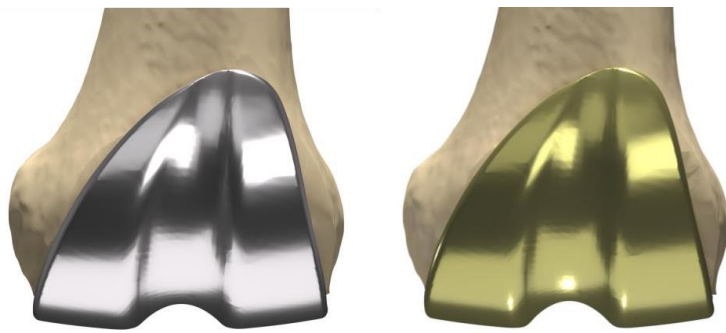
Challenges

- Creating patient-specific prosthetics
- Increase quality of life of Total Knee Replacement patients

Project duration: 9 months

Industrial sectors: Healthcare

Consortium coverage: Italy, Netherlands, Germany



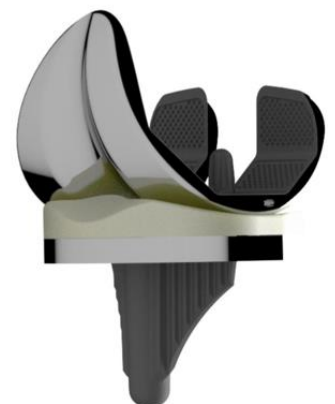
Rejoint is an innovative Italian company founded in 2016 with the goal to pioneer in the use of Electron Beam Melting (EBM) as an additive manufacturing technology to produce patient-specific, custom made, computer aided, orthopaedic replacement systems. Their mission is to improve and revolutionise the traditional way of thinking with regards to the production and sales of orthopaedics: from patient-specific implant design to IoT connected rehabilitation.

The Challenge

Total Knee Replacement (TKR) surgeries are among the most common orthopaedic procedures performed today. However, up to 30% of patients are unsatisfied with their knee replacement. In most cases, this is due to wrong sizing of the prosthetic implant. Overhang (oversizing) and under-hand (under sizing) of the implants generate lots of problems for patients and their experienced quality of life due to kinematic conflict, tendon impingement between implant devised, as well as pain, inflammation and bleeding. To address this problem, Rejoint has developed YourKnee, a Total Knee Replacement system which provides a patient-specific approach to the pre-operative planning, best-fit implant identification & positioning, a patented surgical technique, and data-driven follow-up to support patients in their rehabilitation process. Although YourKnee represents a large advancement in not only the development of customised prosthetics, but also the surgical process itself, there was still room for development and improvement to solve the issue of patients being allergic to bone cement and the associated problems such as inflammation, infection, arthrofibrosis, swelling and pain.

The Project

Within this project, Rejoint aimed to develop and validate a new patient-specific 3D printed orthopaedic implant for Total Knee Replacement procedures. The aim of the project is to develop a titanium tibial tray with embedded lattice structure and to validate the process related to the removal of unmolten titanium powder on the tibial tray. Through the introduction of a titanium tibial tray, integrated with the trabecular structure, the use of bone cement can be avoided altogether, thus providing a safe solution to all patients. The embedded lattice structure allows for better vascularisation and regrowth of bone tissue, leading to safer and natural osseointegration, reducing the risk of the implant becoming loose.





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Role of the Facility Centres

To execute this project, Rejoint partnered up with the Fraunhofer Project Centre at the University of Twente, based in the Netherlands, and the Fraunhofer Institute for Production Technology based in Germany. Within this partnership, the roles were clearly divided; Rejoint provided the initial design and produced the prototypes necessary to perform initial tests and validation. The Fraunhofer Project Centre at the University of Twente was in charge of the development of a lattice structure design following the project specifications. This design was created by an algorithm to generate a random lattice structure with a defined pore and truss size. Once the design has been finalised, Rejoint manufactured new prototype implants, incorporating the design. Fraunhofer IPT was in charge of performing the tests on the new prototypes, focussing on the cleaning process and verifying the final quality of the implant and the porous structure. In order to select the most suitable cleaning process, an evaluation was conducted of the currently available cleaning methods, assessing the advantages and disadvantages associated with each method. Based on this evaluation, the most suited cleaning methodology was selected.

Results achieved

The successful execution of this project has allowed Rejoint to reach the market with a complete array of patient-specific solutions for Total Knee Replacements. Furthermore, Rejoint is the first European company which is capable of delivering a patient-specific, EBM 3D printed tibial tray in titanium with a lattice structure. Through the adoption of additive manufacturing to produce the prosthetic, the overall manufacturing costs and lead time of the devices has been reduced significantly and its potential could represent a new step for the medical industry as a whole. The solutions which have been developed through this project can also be translated for the development of various prosthetics and other subject-specific post-traumatic implants. Rejoint is currently in the process of commercialising their new product in order to make it available for healthcare professionals and the medical sector.

