New type of biocompatible materials for customized medical implants made by Selective Laser Sintering (SLS) and Selective Laser Melting (SLM) - BIOMAPIM

Complex Exploratory Research Project

Period: 2010-2013
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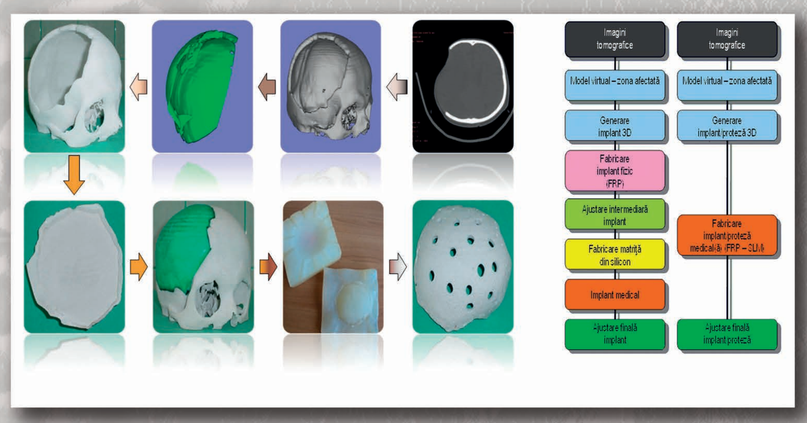
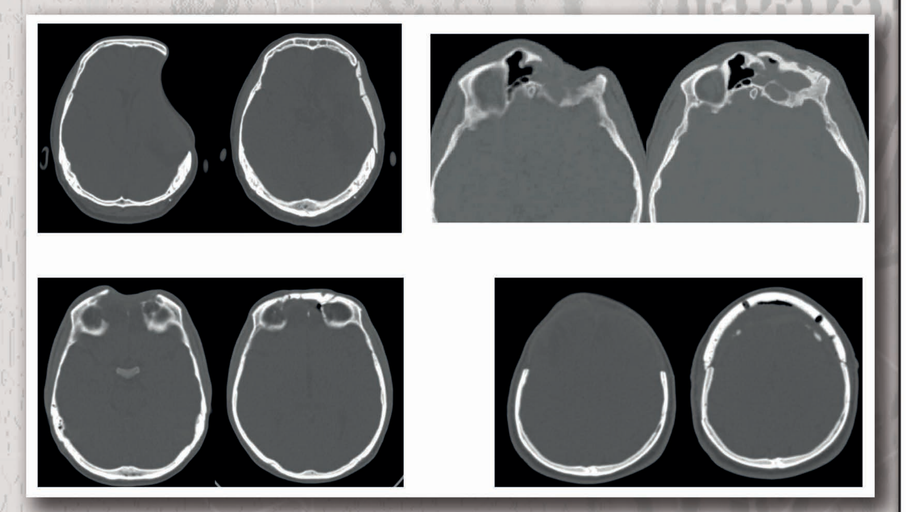
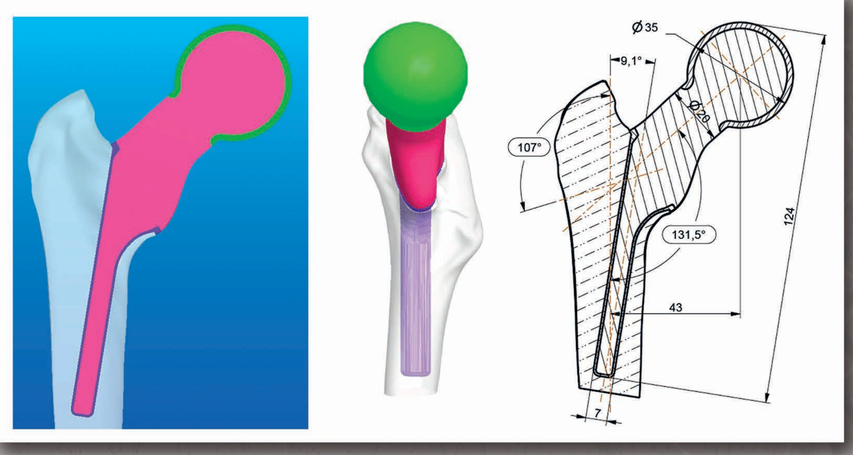
Objectives:
The main objective consisted in finding specific solutions to the complex issues related to the design and manufacturing process of customized medical implants made from biocompatible materials, metallic or non-metallic, through:
- research concerning new type of biocompatible materials to be used within SLS and SLM processes
- research concerning the improvement of biocompatibility and bioactivity of medical implants made from new type of materials
- research regarding the virtual CAD models and physical models of medical implants manufactured by SLS and SLM





Achievements:
It is well-known the possibility to use Additive Manufacturing (AM) processes to produce prototypes, starting from a virtual CAD model of a developed product. The complex research started at the Technical University of Cluj-Napoca (TUC-N) within an inter and trans disciplinary consortium including specialists from Babes-Bolyai University, the Oncology Institute and the University of Medicine and Pharmacy from Cluj-Napoca has been focused on the possibility to use these type of methods in order to produce customized medical implants made from different types of biocompatible materials, metallic or non-metallic, using the information data taken from a CT or RMN for a specific area of a bone. The made research were focused not only on the possibilities of reproducing different geometrical shapes of the customized medical implants, but also to the possibilities of preparing the implant before surgical operation, in order to provide its rapid bio-integration in the implanted area. Based on these research objectives, there were produced and successfully tested new type of methods to be used for different types of porous structures made from composite materials (titanium alloys mixed with other type of materials such as hydroxyl-apatite or bioactive glasses) with a high level of biocompatibility and bioactivity as well. All new types of developed materials produced by using Additive Manufacturing technologies (SLS and/or SLM), were further on tested in vivo and in vitro, in laboratory conditions, by using different type of animal subjects (rats, rabbits, etc.), confirming that the Additive Manufacturing technologies could be successfully used in order to produce customized medical implants made by SLS and/or SLM. One of the most important results of made research is related to the designing process of new type of medical implants, in such way as their structure and properties will be as closed as possible to the one of the substituted bone.



Application domain:
The research in this field was started at the Technical University of Cluj-Napoca (TUC-N) more than 10 years ago. Since then, more than 60 human patients were main beneficiaries of the results obtained within made research. The different types of medical implants made from biocompatible non-metallic materials by indirect methods at TUC-N were successfully further on used within surgical operations by the doctors from Maxillo- facial and Neurosurgery Clinics from Cluj-Napoca. The results obtained recently in 2013 have offered the possibility to produce the first type of a customized medical implants made by SLM at TUC-N (part of a destroyed zygomatic bone for a human patient that suffered a car accident), being successfully implanted afterwards. The possibilities of using this type of Additive Manufacturing technologies and results of research made at TUC-N are more than obvious. There are many patients suffering major accidents or having different types of severe diseases/congenital malformations, which could be the main beneficiaries of such technologies and solutions developed at TUC-N.