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PhD THESIS ABSTRACT

Research on optimizing customized prostheses

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This thesis aims to develop a virtual surgery planning methodology starting from the traditional Total Hip Replacement preoperative planning and having as final goal the realization of a template prosthesis that can be customized according to the femoral landmarks of each patient. Starting from the traditional preoperative planning of THR, which is done on the patients' X-Ray and using the same principles of obtaining femoral landmarks, the CT scans of a patient with hip joint related disease that need to undergo a THR surgery were segmented by using specific algorithms in order to extract the patients' femur and after that was imported in dedicated CAD software in which, with the help of evaluation instruments, all the patients' femoral landmarks were identified. These femoral landmarks were used to develop a custom prosthesis starting from a standard anatomical femoral stem, which was validated using FEA simulations.

Based on the information obtained, the development of a software coded in Python language was done to create somehow a tool that allows the analysis of patients' CT scans in MPR view, but also in 3D view. It allows the bone segmentation of the affected area in order to obtain a CAD model file and perform the virtual preoperative planning in a CAD dedicated software, and finally use some of these dimensions in order to personalize a custom hip stem based on a pre-existing stem model used as basis for the desired geometrical transformations.

The work is completed by printing it with FDM technology, using a biocompatible material to demonstrate the potential of this study, the versatility and the possibility of orienting the femoral stems used in THR towards personalization and AM, avoiding the use of standard prostheses that can lead to postoperative complications and thus leading to the elimination of prostheses "*banks*" due to the fact that they would no longer be necessary.