3D RECONSTRUCTION CUTTING AND SMART DEVICES FOR PERSONALISED MEDICINE

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The 5D printing of anatomical models requires smart devices to assure the continuous improvement. Thus, after functional elaboration, we printed and scanned 5 glenoids by CT, to obtain 5D models as potential surgical devices.
Keywords: 3D reconstruction cutting, 5D personalised medicine.

1. Introduction

The 5D printing [1] of anatomical models needs a high-defined digital image. Nevertheless, the high number of variables and the limits of elaboration softwares not always allow the direct printing of the selected object. In this framework, a functional elaboration of the anatomical shape is required. Hence, we printed polylactic acid (PLA) replicas of 5 glenoids from computer tomography (CT) images using the novel 3D reconstructing cutting [1] method (3DRC) to manage the 3D printing process. After digitalisation of the final 3D model, via 3D scanning technologies, we wanted to verify the predicted [2] printing process parameters [3], for future feasibility comparison between the values obtained from the curved Multi Planar Reconstruction cMPR and the standardised 'Pico' method [4].

2. Materials and Methods

We acquired and elaborated 5 different glenoids from dead patients with Dual-source CT (Siemens Medical Solution, Forcheim, Germany). The resulted .STL file was imported in the SolidWorks2015 (Solidsolution, London, U.K.) software for the dimensions evaluation obtaining values usefull for the additive manufacturing technology. We printed the glenoids via fused deposition modelling (T_{bed}=53°C, T_{head}=191°C and speed=12mm/s) using PLA filament and finally we acquired the printed glenoids with EinScan Pro 2X Plus scanner 3D (SHINING 3D Tech. Co., Ltd., Hangzhou, China).

3. Results and discussion

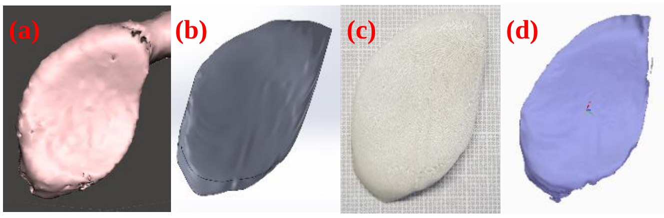
The continuous improvement of a 5D printed models (Table 1) requires: 1) the acquisition with CT or magnetic resonance imaging (MRI); 2) the digital segmentation of the object; 3) the 3DRC processing, restoring the real functional shape. Once obtained the digital model, we finally assured the adherence with the printed one, utilising a 3D scanner, obtaining all the values required to set the printing parameter via the computer aided tissue engineering. The error caused from manufacturing method and scanner accuracy was under 200µm.

4. Conclusion

Merging the cMPR with our new method (3DRC), we demonstrated the ability to realise 5D models for personalised medicine. It is possible to realise 5D models with the aim to reduce surgical failures and to improve the synthetic object implantation, utilising smart devices.

Table 1 Anatomic 5D continuous improvement

Automated predictive innovation	Human–Cyber–Physical Systems	
Big data analysis	CT or MRI	(a)
Advanced diagnostic	3DRC	(b)
New generation of intelligent manufacturing	Additive manufacturing for health	(c)
Zero failure activity	3D model acquisition and analysis	(d)



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