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Abstract

AI-based 3D-printing strategies for patient specific implants in maxillofacial surgery

R. Smeets[1], S. Fuest[1], P. Imgrund[2], P. Gromzig[2], C. Böhm[2], L. Röhrich[2], A. Seibel[2], Y. Löw[2], P. Lindecke[2], F. Avani[1], J. Krösbacher[1], L. Vari[1], S. Eilermann[3], I. Kelbassa[2], M. Gosau[1], and O. Niggemann[3]

[1] Department of Oral and Maxillofacial Surgery; University Medical Center Hamburg-Eppendorf, Hamburg, Germany
[2] Frauenhofer Institution of Additive Manufacturing Technologies IAPT, Hamburg, Germany
[3] Faculty of Mechanical Engineering, Helmut Schmidt University, Hamburg, Germany
[*] Corresponding author, email: r.smeets@uke.de

A n orbital floor fracture can be the result of a blunt trauma and may lead to enophthalmus, diplopia or even vision loss [1]. In the case of a severe injury, reconstructive surgery with titanium implants can be indicated [2]. Because of the limited intraoperative view and the complexity of the anatomical region, there is special need for a patient-specific solution to ensure precise reconstruction [3]. A major obstacle for the use of PSIs is the currently time consuming and expensive manufacturing process, which is characterized by many individual manual steps. In this project, the processes were fully automated and integrated into an end-to-end automatic digital value chain. First, an artificial intelligence (AI) based automatic segmentation of the bony skull out of CT-Data is performed using Dense U-Net [4]. Subsequently, the defect is reconstructed using a statistical shape model (SSM), which was trained by using a public Dataset [5]. The outcome of the SSM is used to create a virtual PSI design, which is once again designed by an artificial intelligence. Finally, the implant is produced via additive manufacturing (AM), followed by post-processing to obtain the required surface qualities. In summary, the exclusive input consists of medical image data that is automatically processed into an output of the physical implant. This study focuses on the created SSM. The input consists of a 3D model of the skull with an orbital floor defect and the output of a 3D model with the reconstructed orbit. The aim of this study is to determine the precision of the "Statistical Shape Model", created in the course of the project „DigiMed“(REACT-EU), for reconstruction of the orbit using orbital volume measurement. In an exemplary evaluation a volume difference of 0.17 cm3 could be achieved. Nevertheless, minor improvements still need to be made to the SSM, in order receive equally precise results for every reconstruction.

AUTHOR'S STATEMENT

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