Transactions on Additive Manufacturing Meets Medicine
Trans. AMMM, 2023, Vol. 5, No 1, Suppl. 1, Article ID 1122, 1 Page

Infinite Science Publishing

Abstract

Intra-operative individualized implant manufacturing and positioning using *in situ* 3D printing– Illusion or reality?

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In order to achieve highest function and improved life-long implant survival, the latest development steps in medical implant engineering include a superior degree of personalization and individualization. Such individualization is addressed by either manufacturing custom made implants adapted very closely to the individual patient´s anatomy or the use of robotic /navigation tools for individual positioning of conventional implants.

However, with these principles still major shortcomings must be accepted: a truly perfect fitting is limited as well as individualized implant material grading and specific implant anchoring are restricted.

3D printing offers the opportunity to manufacture patient-specific implants, which improves treatment success. In Hannover Medical School, different surgical departments already use patient specific 3D-printing technology. Metal based 3D-printed implants are used in total knee arthroplasties [unpublished data] and bone substitution of large bone defects, e.g. after tumor removal [1]. Silicone based 3D-printed stents are fabricated for external ear canaloplasty in otolaryngology [2].

Different companies already offer commercial patient-individualized 3D printing. However, the process is time consuming due to the necessity of defect imaging in the clinic, fabrication in external companies outside the hospital and subsequent implantation in the clinic. To overcome these current deficits, we propose a technological step in medical implants – direct 3D printing of implants in situ. Potential advantages with this concept are evident: no external implant manufacturing is needed, undercutting may allow improved anchoring and implant grading may represent the base for advanced functional capabilities.

Although different techniques are already established for ex vivo 3D-printing, high demands for in situ printing exist, which include e.g. specific profiles of requirement, work flow, path planning, application safety and functional reliability, with special challenge of temperature control. A collaboration between physicians, natural scientists and engineers pick up the challenge to transform illusion to reality.

Author's statement

Conflict of interest: Authors state no conflict of interest.

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DOI: 10.18416/AMMM.2023.23091122