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BIOPRINT FIRSTAID: A HANDHELD BIOPRINTER FOR FIRST AID UTILIZATION ON SPACE EXPLORATION MISSIONS

Abstract

Today, human exploratory missions to Moon or Mars are considered the next steps in human space exploration. Such activities result in humans being exposed to the space environment for long time with increasing distances from earth and no quick return possibilities. Crews on these kind of missions have to be self-sustaining, not only concerning food and water supply, but also medical treatment. Environmental conditions in space, such as the influence of altered gravity, radiation or isolation, raise health issues. As one result of the ESA "PLT-Space" study, superficial skin wounds are likely scenarios to face during (space-) exploration missions. Bio-regenerative approaches like bioprinting offer capabilities for improved treatment and can be applied as part of first-aid strategies. Mobile, handheld tools can incorporate this approach and offer a possibility of *in-situ* wound treatment. For the "Bioprint FirstAid" experiment performed by ESA Astronaut Matthias Maurer on-board the ISS, OHB System AG Bremen and TU Dresden have developed a handheld Bioprinter tool to demonstrate the feasiability of handheld bioprinting under Space conditions. The device consists of a handle capable of holding an exchangeable "Ink Printing Unit" containing two separate gel-like components (Bioink and Crosslinker), which are extruded during a printing process through a nozzle and form a skin-cell containing bioink-band-aid. The nozzle design enables an equal distribution of cells within the printed pattern. Once both components have contacted each other, a gelation process forms a cross-linked hydrogel. This hydrogel provides a humid, but flexible and adhesive layer comprising skin-cells to protect a superficial wound and improve the healing process. In the frame of the "Bioprint FirstAid" Experiment, no human skin cells were used, but fluorescent microparticles to simulate the cell distribution. The experimental design comprises testing of the hardware, consisting of the handle and four Ink Printing Units with different Bioink and Nozzle combinations. The band-aid layers are printed on foil patches, which are returned to earth as samples for study and comparison with identical ground tests with incorporating human skin cells. The experimental study is not just limited to feasibility and sample examination, also the preparation of bioinks and cultivation of bioprinted constructs need to be addressed to further develop bioprinting techniques for space- and ground applications. The Bioprint FirstAid project is coordinated by the German Space Agency at

the German Aerospace Center (DLR) in Bonn and founded by the Federal Ministry for Economic Affairs and Climate Action (BMWK).