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INVESTIGATING THE FEASIBILITY AND DESIGN OF A MICROGRAVITY SURGICAL WORKSTATION

Abstract

As humanity plans for long-duration crewed missions to Mars and beyond, astronauts will need more autonomy and training to deal with medical emergencies. Significant communication delays and long evacuation distances mean a surgical workstation will be a necessity on a spacecraft and could save lives. The aim of this study was to assess the feasibility and design of such a microgravity surgical workstation. This research was conducted using two main approaches: the first was a thorough literature review to summarise current knowledge and inform the enclosure design; this was followed by an iterative process to perfect a workstation design proposal. Notably, a similar surgical enclosure has never been investigated and very few containment solutions have been tested in parabolic flight. This study proposes the design of a Crew Operating Microgravity Theatre Enclosure (COMTE), which has been shaped by conclusions from parabolic animal surgery experiments and by feedback from space medicine experts and astronauts. A full technical characterisation of the proposed design is included in this report, and a prototype was constructed. The defining principle of the COMTE 'glovebox' was to use the capillary edge-effect of fluids in microgravity to contain surgical fluids and blood during an operation. This aims to improve operator visualisation of the surgical field, whilst maintaining a sterile surgical site and preventing contamination of the closed-loop spacecraft atmosphere. Additionally, the proposed design includes extensive research on weight, volume and power requirements, and has been reviewed by external experts. This research not only safeguards astronauts but could present a unique solution to terrestrial surgery in remote and extreme environments. In conclusion, this presentation proposes a novel solution to the problem of safe and efficient surgery in space, and further work on the design will lead to testing on the ground and in parabolic flights.