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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, astronauts will need more autonomy and training to deal with medical emergencies. Medical care and surgery for humans in space is a small but mission critical research field. Significant communication delays and long evacuation distances mean a small, light surgical workstation will be a necessity on a spacecraft and could save a life.

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 on possible surgeries needed in space; this was followed by an iterative design process to perfect a workstation design proposal. A similar surgical enclosure has never been planned and very few successful containment solutions have been tested in parabolic flight.

This presentation proposes the design of a Crew Operated Microgravity Theatre Enclosure (COMTE), which has been shaped by lessons learnt in animal surgery experiments and by feedback from space medicine experts and astronauts. A full technical characterisation of the proposed design is included in this paper, and a prototype is currently being built. The defining principle of the COMTE 'glovebox' is to use the capillary edge-effect of fluids in microgravity to contain surgical fluids and blood during an operation. This will improve operator visualisation of the surgical field, while keeping the surgical site sterile and preventing cabin atmosphere contamination. This presentation proposes a unique 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.

In conclusion, the literature proves performing surgery in space is possible with the right enclosure and tools; thus, this study will propose a feasible enclosure solution. With previous experiments only testing animal surgery in a glovebox, there is a gap in understanding of the design of a suitable workstation for human surgery. The proposed design includes extensive technical 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.