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Abstract

3D-Printed Fixture for Biological Tissue Training on the Lübecker Toolbox

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Surgical training simulators are essential in medical education, allowing trainees to develop technical skills in a controlled environment[1]. Many simulators, including the default Lübecker Toolbox fixtures, fail to replicate the tactile and mechanical properties of the living tissue. This gap between simulation and clinical reality presents a significant challenge, potentially increasing the operation time and complications[2]. Moreover, the psychological aspect of handling biological tissues is often overlooked. In this study, we address these limitations by developing a customized 3D-printed fixture for the Lübecker Toolbox that allows for training suturing on ex-vivo porcine feet.

Shapr3D CAD software was used to design a fixture that securely positions porcine feet within the Lübecker Toolbox. One challenge of including biological tissue into surgical training is to allow for a fair performance comparison across the variety of porcine feet. Thus, we propose to perform several cuts of fixed length at standardized locations of the foot. To this end, we designed a 3D-printed stencil to ensure reproducible cuts. The fixture and stencil were manufactured using a Bambu 3D printer with PLA. Three surgical trainees evaluated the integrated system via questionnaires.

Feedback from all surgical trainees confirmed the successful integration of the 3D-printed fixture with the Lübecker Toolbox, providing a stable training setup. The proposed design maintained consistent positioning relative to the simulator's integrated camera. Moreover, the use of biological tissue offered more authentic tactile feedback compared to artificial materials and the 3D-printed stencil enabled standardized tissue cutting for suturing practice.

This study demonstrates that 3D-printed fixtures can effectively incorporate real tissue into surgical simulation, enhancing training authenticity and standardization. Our approach offers a cost-efficient, reproducible solution that can be integrated into existing simulators. Future work will expand on this concept by testing additional tissue types and evaluating the impact on clinical skill transfer.

AUTHOR'S STATEMENT

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