Educational Efficacy of a Procedural Surgical Simulator in Plastic Surgery: A Phase I Multicenter Study

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Abstract

Background: The use of computer simulation to facilitate training across surgical specialties has become increasingly popular in recent years. It is now mandatory that general surgery residency program curricula incorporate teaching in a skills laboratory[1]. The efficacy of these tools has been supported in literature; however, there remains limited development and use of simulation to facilitate training in plastic and reconstructive surgery. Interactive 3D visualization technology can address this need by facilitating comprehension of complex anatomy via unique visualization, as well as critical steps of a given procedure.

Methods: Using previously developed cleft lip and palate simulation technology, our team developed an interactive virtual model which demonstrates a latissimus musculocutaneous flap breast reconstruction technique following mastectomy (Figures 1 and 2)[2,3]. The procedure was divided into discrete tasks by members of the American Council of Academic Plastic Surgeons (ACAPS) Ad-Hoc Committee on Virtual Reality and Simulation using a modified Delphi method. Critical didactic points were identified. Interactive multiple-choice questions were developed to provide an objective assessment of cognitive competency, incorporating both anatomical and procedural knowledge.

A Phase I multicenter pilot study was conducted at four U.S. medical centers. Medical students and residents used the simulator’s 3D interactive tutorial, augmented by voiceover and didactic labels. 37 subjects completed tests before and after using the simulator.

Figure 1: BioDigital Latissimus Musculocutaneous Flap Simulator; Close-up, Implant Insertion
Results: Preliminary results indicate that training on the BioDigital Latissimus Musculocutaneous Flap Simulator enhances procedural knowledge and understanding. Scores were significantly higher after using the simulator, with a mean improvement of 3.24 out of 21 questions; average pre-test score is 17.00 (81.0%), while average post-test score is 19.47 (92.7%) (paired t-test, p < 0.0006). The data demonstrated a significantly positive correlation between time spent using the simulator and improvement in test scores.

Conclusions: The described simulator is currently the only cognitive plastic surgery procedure simulator that includes peer-reviewed steps and has been tested across several training programs. This study suggests that this simulator is an effective tool for surgical education, and validates step-based cognitive simulation in the field of plastic and reconstructive surgery. Next steps include technological improvements, further validation, and development of additional simulators to construct a virtual library of procedures.

References

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Disclosure/Financial Support

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.