Investigating the Success of Dermatologic Procedures with Silicone Skin Models

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Abstract

The purpose of this study is to evaluate the effectiveness of existing dermatologic simulators for the training of novice learners in common medical procedures. More specifically, our interest lies both in assessing the skills and comfort of these learners but also to pave the way for a novel, enhanced dermatologic simulator. Previous studies have shown medical students receive relatively minimal training in suturing techniques using various types of models during their pre-clinical years (Blau et al., 2020). However, most of these models fall short in accurately simulating the experience with human patients, leaving many students anxiety-ridden as they enter their clinical years. The majority of training simulators found on the market today lack validation from medical learners (Gallagher et al., 2020). In a similar light, the abundance of skin tone misrepresentation of such simulators has contributed to the disenfranchisement of modern-day dermatologic study (Perlman et al., 2021). This review aims to highlight the utility of current models and trends in dermatologic simulator creation. Through our study, we hope to develop our own unique model to increase the efficacy and confidence of medical students in dermatologic procedures. The ideal dermatologic model should serve as a multi-purpose skin trainer designed to provide a high-fidelity dermatologic experience for visual, tactile, and kinesthetic learners. Inclusivity of skin tones, particularly those of marginalized populations, should be at the forefront. It should reflect true-to-life aspects of human skin, with distinct epidermal, dermal, and hypodermal layers. Further, its use should expand beyond simple suturing to include procedures like shave and punch biopsies, cyst removal, and more. We look forward to taking this review into our next endeavor.

Methods

Current literature regarding dermatologic procedure education, available skin models, and medical student training was reviewed. Though our primary focus in this search was the nature of the skin model or dermatologic trainer used, we were also intrigued by the types of training programs and usage instructions in these studies. In addition, studies including direct feedback from medical students or other health professionals were of particular interest. Inclusion criteria for articles of interest were English language, peer-reviewed, and published between January 2013 and January 2023. The following databases were utilized in the development of this review:

- PubMed
- Simulation in HealthCare
- Research Gate
- Google Scholar

- Key words and terms utilized include: "medical student", "simulation", "suture", "dermatologic training", "skin model", "punch biopsy", "shave biopsy", "clinical education"

Outcomes

- We noted a direct comparison between dermatologic educational training utilizing human skin and synthetic tissue. Figures 1 and 2 show that there was no significant difference in suturing scores or learner confidence when comparing students who trained on cadaveric tissue versus synthetic tissue (Blau et al., 2020). However, this still proposes the question of cadaveric tissue's reliability as a substitute for a patient's skin. Another study utilized fresh human skin in the operating room after it had been excised during post bariatric surgeries. The results revealed a significant improvement in the student's competency (Rothenberger et al., 2015).

- The use of a model with multiple laceration sites was developed with a 3D printed mold to be used in a study with 39 medical students (Gallagher et al, 2020), but the only skill that was assessed was suturing. One other silicone model was developed that had multiple lesions, including a nodule, plaque, pustule, and others. This study demonstrated that students experienced a significant improvement in their skills after working with this model (Clanner-Engelshofen et al., 2022).

- It was disappointing to see the lack of studies incorporating diverse skin tones in their efforts. This underrepresentation inevitably leads to shortcomings in visual diagnostic skills and pattern recognition as medical students enter the clinical realm (Perlman et al., 2020).

- A majority of these studies include medical students but fail to include practicing physicians armed with substantial training in dermatologic procedures. Of the studies utilized in this review, the participants included 43 first-year medical students (Blau et al., 2020), 39 undergraduate medical students (Gallagher et al., 2020), 222 undergraduate students at the Medical Facility of the Ludwig Maximilian University of Munich (Clanner-Engelshofen et al., 2022), and 15 medical students in their pre-final year (Rothenberger et al., 2015). This emphasizes an interesting area of exploration moving forward.
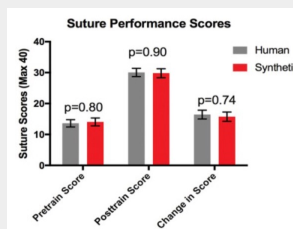

Figure 1. Suture performance scores between human cadaveric tissue and synthetic tissue (Blau et al., 2020).
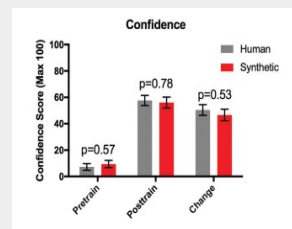
Figure 2. Learner confidence scores between human cadaveric tissue and synthetic tissue (Blau et al., 2020).

Discussion and Conclusion

Summarizing the findings, it is apparent that existing dermatologic training models, though effective in achieving sound suturing results, lack a focus for broader applications in Dermatology. This includes likeness to the complexity of human skin, efficacy in multiple procedures, patient representation, backing of clinical experts, and more. What truly drove student confidence in performance seemed to lie in the formal training received as opposed to the training model itself. Remaining gaps in the current literature include the development of multi-procedure training models, the utilization of varying skin tones in diagnosis and manipulation, and the attainment of model-specific physician feedback.

Moving forward, this review reveals a crucial need to create a cost-effective, inclusive dermatologic simulator that has been shaped by the expertise of practicing physicians. A simulator of this nature, which would subsequently allow for more in-depth instruction, would greatly increase students' comfort level in their clinical years. It would also expand a student's basic skill set for residency programs. Future directions may consider the need for broader training programs that encompass more than simple suturing as well as an investigation of the optimal timing of such programs in the grand scheme of medical education.

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