Development of a Low-Cost Suture Pad Solution for Use in Augmented Reality Training

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Introduction and Background

Simulation is vital for surgical training, allowing residents to enhance skills while ensuring patient safety. Realistic simulation environments that mimic life-like scenarios are in high demand but depend on program funding and access to facilities. With augmented reality (AR) and the rise of virtual learning, residents can now engage in immersive training without expensive facilities. Suturing is a fundamental medical skill, making it a perfect candidate for an AR training environment. Thus, this study aimed to create a low-cost, accessible AR suturing solution.

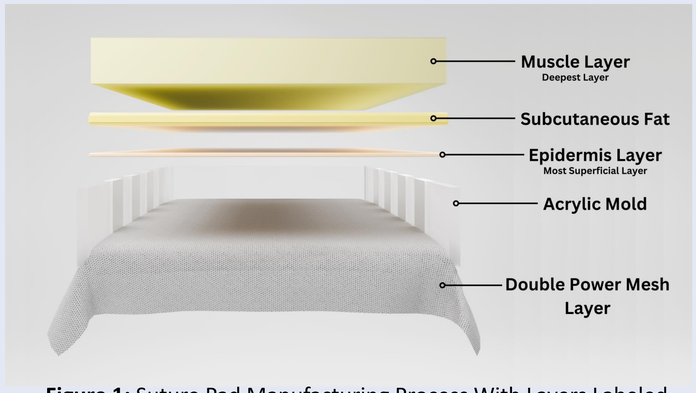
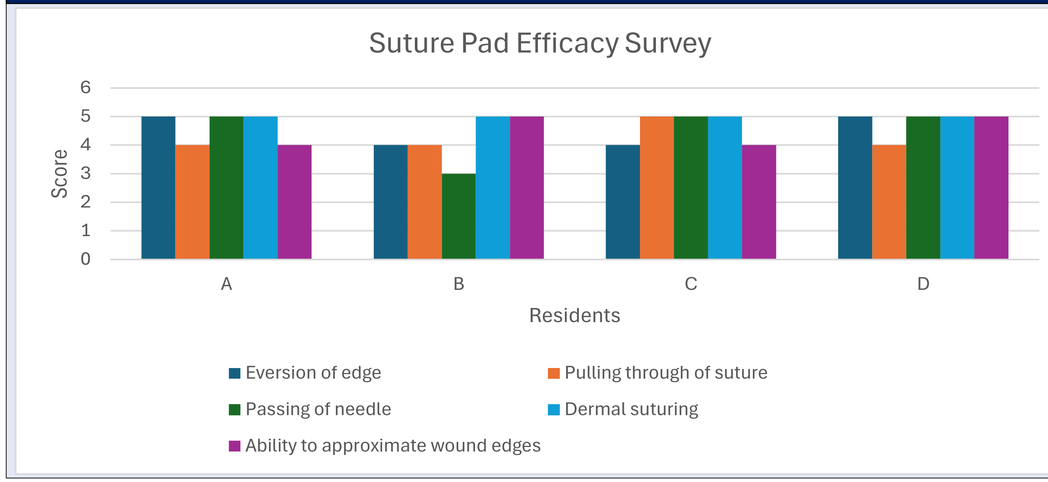


Figure 1: Suture Pad Manufacturing Process With Layers Labeled

Efficacy Survey



Cost Analysis

Our cost of production per 15 in^2 pad is **$3.57**. This table shows the comparison of relative cost, per unit size, by each commercial model.

Model	Model Surface Area (in^2)	Absolute Cost	Relative Percent Cost
Best-Selling Amazon Pad	22.62	$9.79	182%
SurgiReal 3 Layer Pad	13.64	$36.49	1124%
Vata Suture Skill Trainer	42.33	$106.50	1057%
Limbs and Things Pad	27.93	$41.50	624%
SimSkin Suture Pad	36.00	$44.00	514%

Methods

Suture Pad Creation

- Conventional suture pads costs upwards of $50
- We designed a highly customizable, cost-effective solution
- Uses commercially available materials to simulate dermis, fat, and muscle
- Primary material is silicone with power mesh to augment tensile strength
- Developed a high-fidelity, low-cost manufacturing process
- Performed cost-analysis to compare to commercially available solutions

AR Environment

- AR: Immersive environment in which a user wears a head-mounted display (HMD) that projects their real-world view along with 3D visual elements
- Created our environment using Unity 3D (Unity; Unity Technologies, San Francisco, CA) and Blender (Blender; Blender Foundation, Amsterdam, Netherlands)
- 3D models and animation were created in Blender and Unity was used to create the environment
- Environment guides users through a simple interrupted suture technique

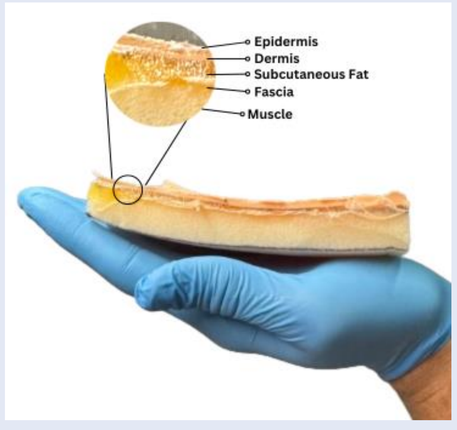


Figure 2: Detailed Image of Suture Pad Layers

Results

Efficacy Survey

- Five surgical residents questioned in five categories to assess efficacy of the pad
- Average overall score of 4.55/5 across all categories (eversion of edge, pulling through of suture, passing of needle, dermal suturing, and ability to approximate wound edges) with dermal suturing scoring the highest

The consensus was that our suture pad offers a competitive price point (at $3.57 per pad), can be used effectively in fascial closures (something many suture pads cannot do), and has the benefit of being issued for personal use.

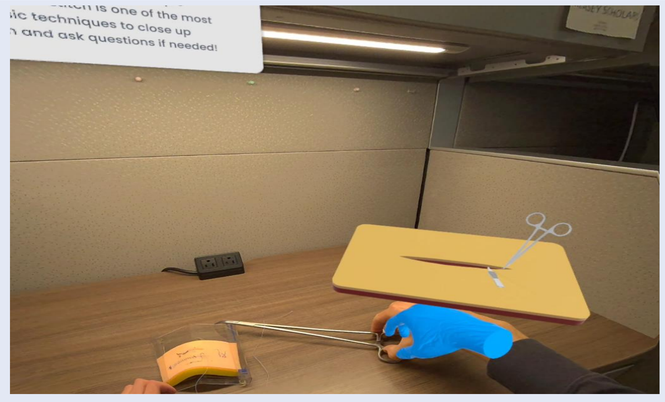


Figure 3: Suture Pad AR Environment

Future Directions

- Develop a method to mass produce the pads – purchasing materials at wholesale prices will drive price even lower
- Perform a larger study against commercially available suture pads – will help establish a baseline as to what can improve with this pad
- Test effectiveness of the AR Suture Pad environment – have residents determine whether this environment improves their skill acquisition