VELOCIGRAFT

Johns Hopkins Biomedical Engineering

Background

Burns are disproportionately fatal in **Sub-Saharan Africa** (SSA) where about **38,000 deaths** occur annually due to extensive, deep burns.[1]

Skin Grafting

The standard of care for burn treatment is skin grafting, involving

- debridement harvesting healthy skin
- of devitalized skin
- fixating the healthy skin over the wound.

Large burns require **graft expansion**, typically performed through meshing, or cutting a pattern of slits into the graft.

The high cost and maintenance of commercial skin meshers—ranging from **600 to 7,500 USD**—limit their use in SSA.[3]

Manual meshing, a cheaper alternative, is **time-consuming** and **less effective**, especially in cases of large wounds.

The Need

Surgeons treating burns in sub-Saharan Africa **need a more economical way of expanding skin grafts** in order to minimize the amount of skin required to close the total surface area of burn wounds.

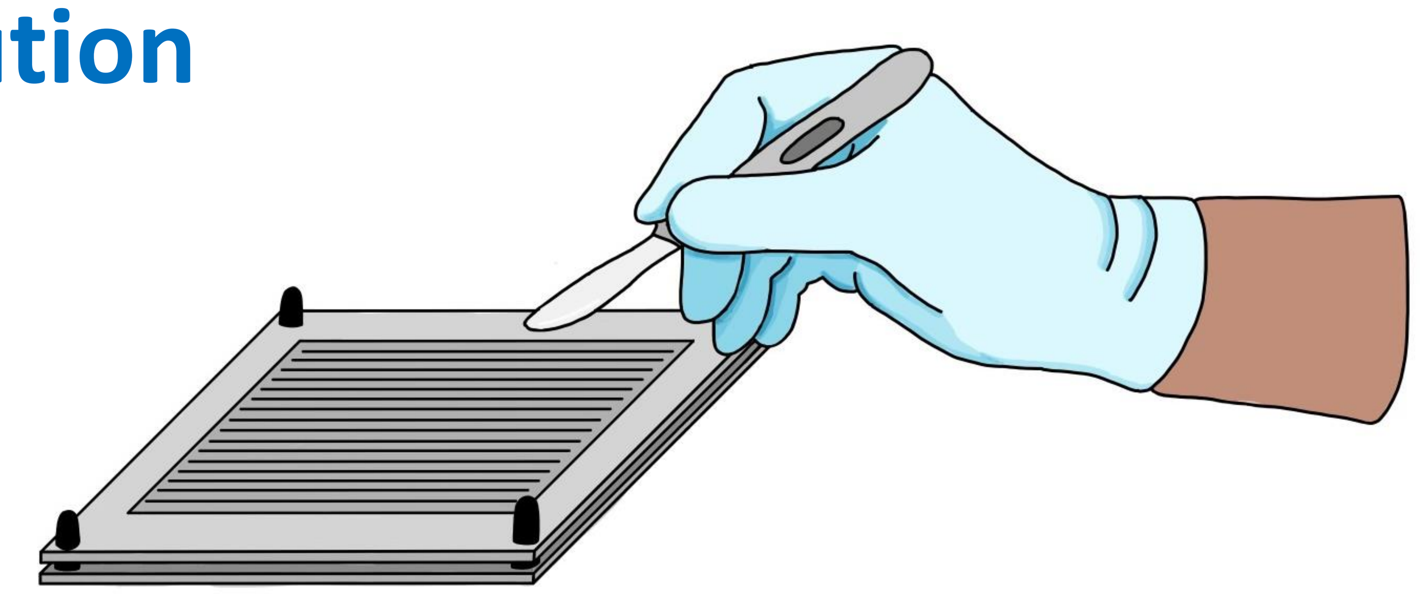
Design Requirements

After interviewing 15 plastic surgeons and observing skin grafting procedures, and researching literature, we developed the following design requirements.

The template must:

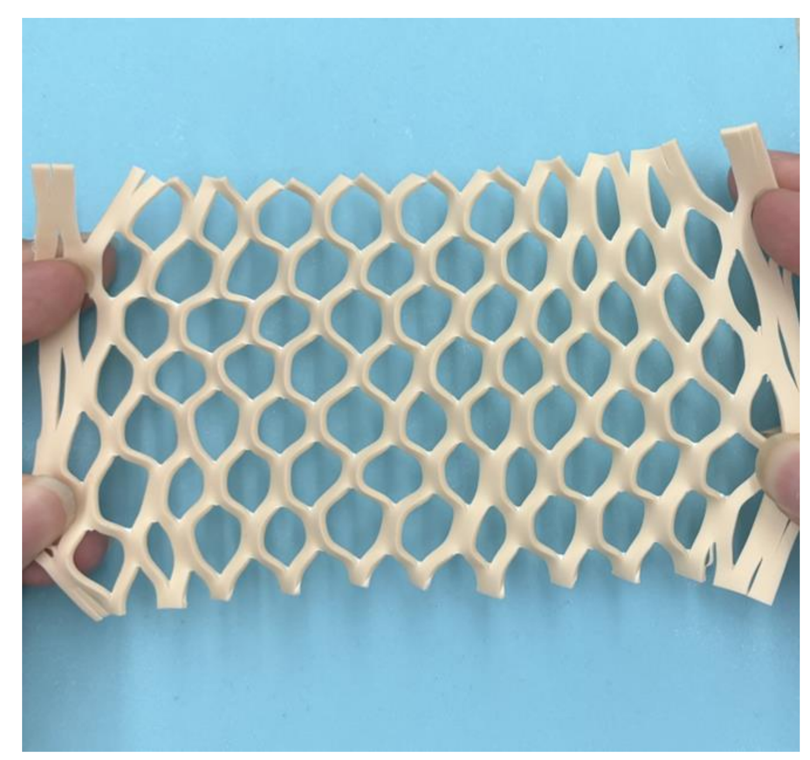
1. Be designed without consumable parts to avoid additional costs.
2. Achieve a 2 (± 0.3):1 expansion ratio for effective large wound coverage.
3. Be autoclavable, withstanding 121℃ for 30 minutes without damage, to ensure it can be sterilized and reused in line with common SSA sterilization practices.
4. Not apply more than 2.45 N of force to the skin graft to prevent damaging the graft's viability.

Solution



A low-cost template for hand-meshing autograft skin proposes faster and more effective coverage.

Unmeshed tattoo skin



Tattoo skin meshed with template and expanded uniaxially

Testing

We meshed a 10cm x 10cm skin graft with a 2:1 expansion ratio.

1. **Time:** Anecdotally, hand meshing this graft would take approximately 10 minutes.
2. **Expansion Ratio:** This measures the ratio between the pre- and post-meshing graft areas.
3. **Void area:** The area of each interstice formed by expanding the meshed skin. This should be minimized to facilitate wound healing.

	Expansion Ratio	Void Area (cm²)	Time (s)
1	1.81	1.69	41.28
2	1.78	1.90	42.66
3	1.71	1.86	43.82
4	1.73	1.12	45.22
5	1.48	1.71	41.87
Mean ± SD	1.70 ± 0.12	1.66 ± 0.31	42.97 ± 1.41

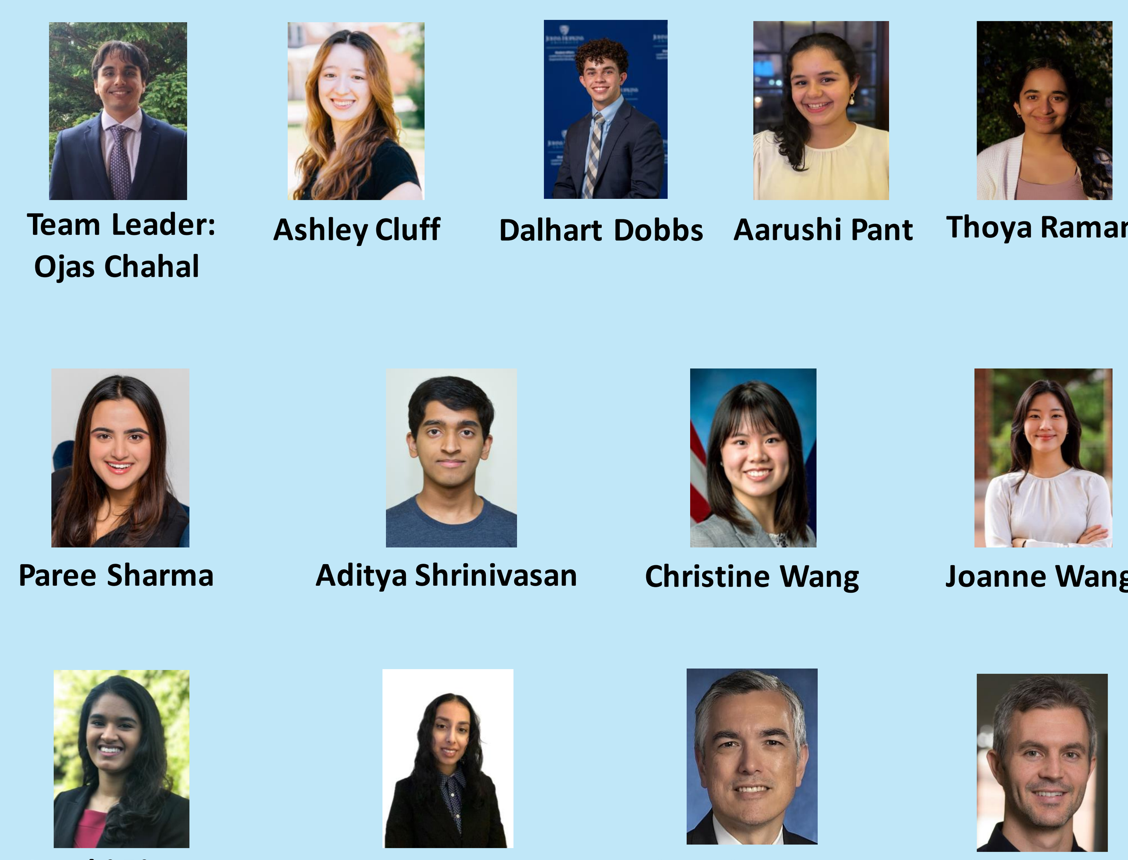
Tested on tattoo skin, our template can achieve close to a 2:1 expansion ratio **10 times faster than hand meshing**, while producing a **smaller average void area per interstice.**

Future Work

Our future goals are to achieve an expansion ratio of **2:1** while continuing to **minimize void area** per interstice.

We would also like to perform validation tests to assess template sterilizability, durability, ergonomics, and skin cell viability after meshing, before translating our design to our clinical partner in Mozambique.

Our Team



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If you want to learn more or follow our progress, please scan the QR code to visit our website!

Acknowledgements

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- We are also thankful for the guidance of Dr. Pedro Santos and Dr. Erica Hodgman in designing the template.

References

1. Collier ZJ, Naidu P, Choi KJ, Pham CH, Potokar T, Gillenwater J. 83 Burn Injuries in Sub-Saharan Africa: A Global Burden of Disease Study. *Journal of Burn Care & Research*. 2021;42(Supplement_1):S57-S58. doi:10.1093/jbcr/irab032.087
2. Sub-Saharan Africa - New World Encyclopedia. Accessed April 21, 2024. https://www.newworldencyclopedia.org/entry/Sub-Saharan_Africa
3. Vandeput J, Nelissen M, Tanner JC, Boswick J. A review of skin meshers. *Burns*. 1995;21(5):364-370. doi:10.1016/0305-4179(94)00008-5