AUTOMATIC DE-EPITHELIALIZATION DEVICE

Advisor: Dr. Krishanu Saha

Client: Dr. Carol Soteropulos

Consultant: Todd Le

2020/10/01

Team Members

Team Leader: Joshua Giarto

Communicator: Young Kim

BSAC: Noah Ruh

BWIG: Colleen Cuncannan, Tatum Rubald

BPAG: Michael Chiariello

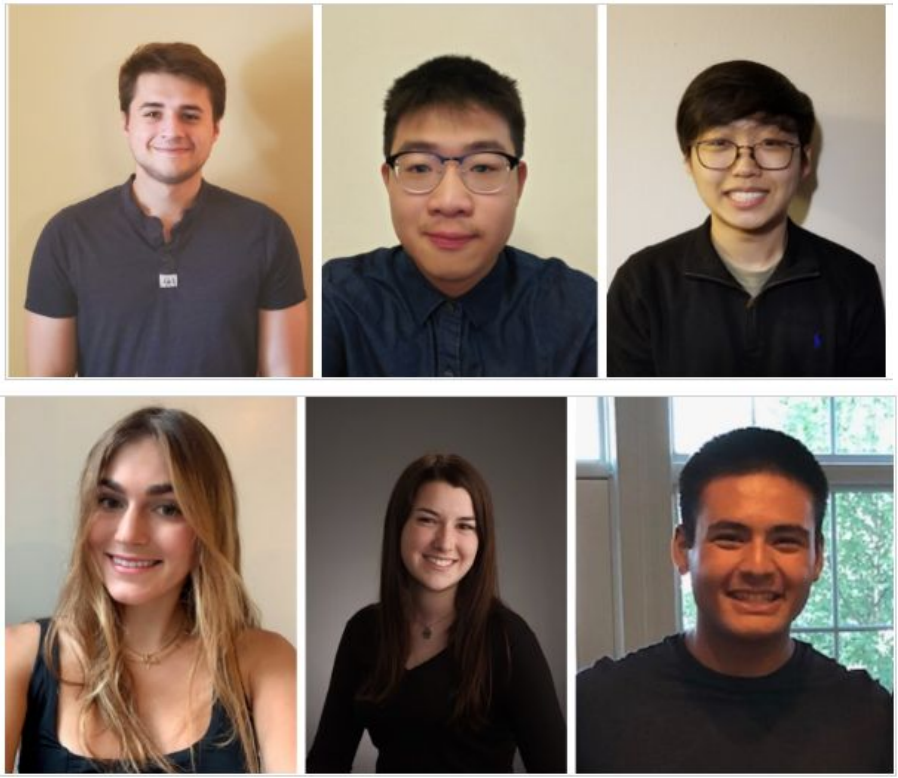
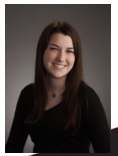


Figure 1: From top-left to bottom-right: Noah Ruh, Joshua Giarto, Young Kim, Tatum Rubald, Colleen Cuncannan, Michael Chiariello



Important Anatomy of the Skin

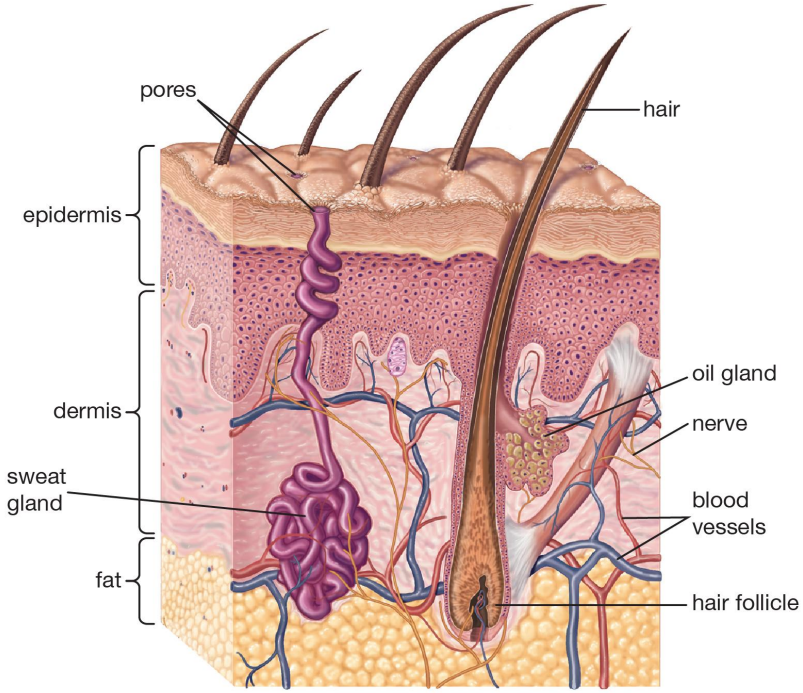


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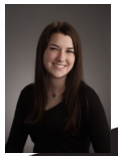
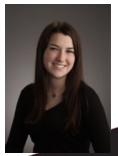
Figure 2: Diagram representing the different layers and components of human skin.
W. Montagna and F. J. G. Ebling, "Pigmentation," *Encyclopædia Britannica*, 01-Apr-2020. [Online]. Available: https://www.britannica.com/science/human-skin/Pigmentation. [Accessed: 01-Oct-2020].



Current Problems with De-epithelialization

- Time consuming [1]
- Inconsistencies in depth [2]
- Lack of tension in the skin

Figure 3: A photo of a current method for de-epithelialization of breast tissue using “button holes”
T. O'Neill and P. Regan, “Button Holes: Novel Deepithelialization Technique in Reduction Mamaplasty,” *Oxford Academic*, 01-Mar-2011. [Online]. Available: https://academic.oup.com/asj/article/31/3/358/193829. [Accessed: 01-Oct-2020].



Current/Competing Products

- EPICUT™ [3]

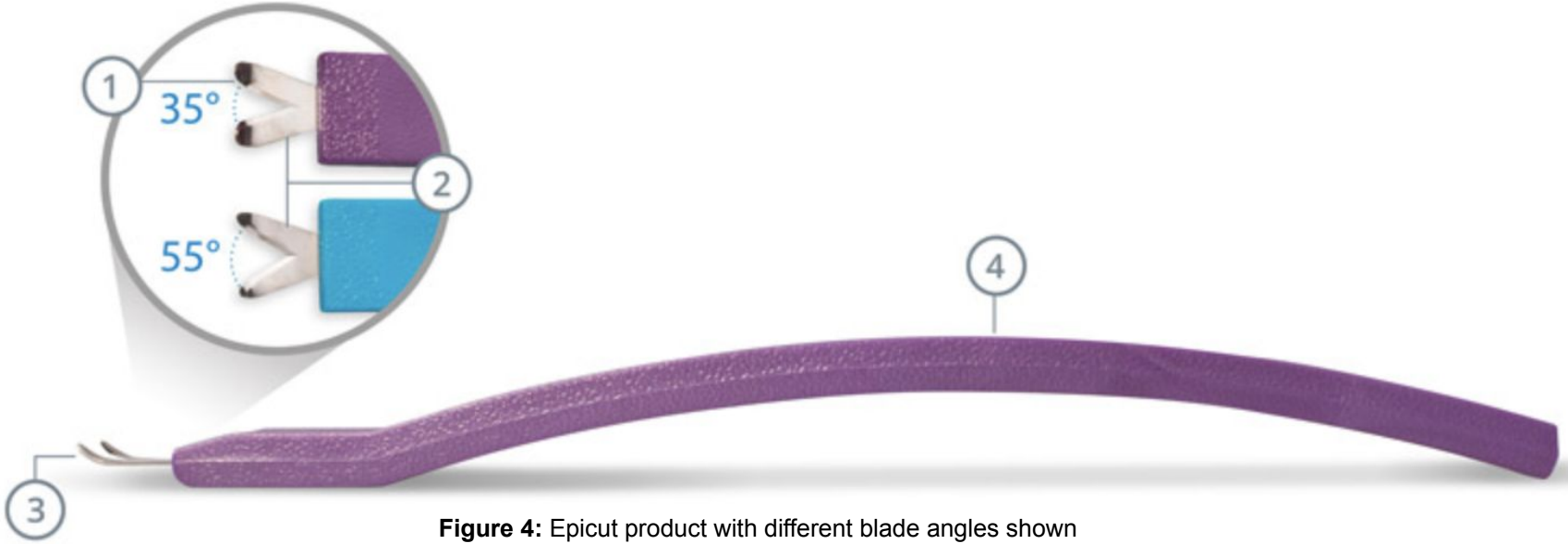
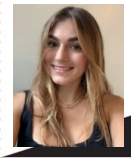


Figure 4: Epicut product with different blade angles shown
MicroAire Surgical Instruments, LLC. 2020. *Microaire Epicut™ De-Epithelialization Device*. [online] Available at: <https://www.microaire.com/products/epicut/> [Accessed 1 October 2020].



PDS-Summary

Function:

- Facilitate removal of epidermis

Client Requirements:

- Efficient
- No significant learning curve
- Uniform depth
  - Tension

Cost:

- $300

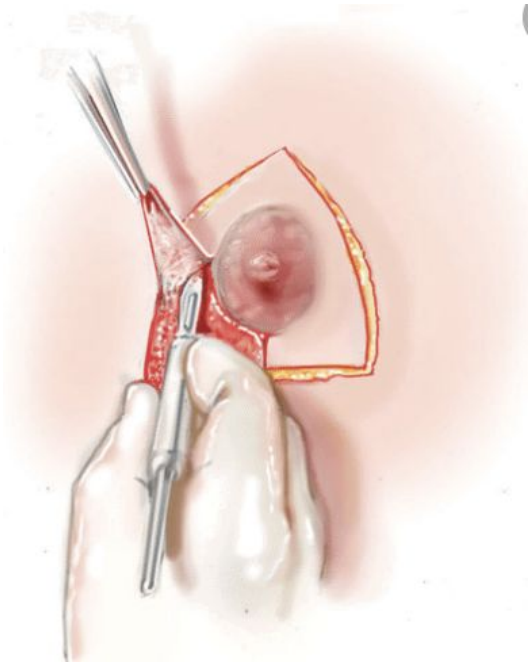
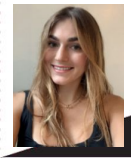


Figure 5: Animated photo of current breast epithelialization process.

2020. [online] Available at: <https://www.researchgate.net/figure/a-Diagram-of-the-flap-after-deepithelialization-b-Diagram-of-the-raised-deepithelialized_fig1_51160939> [Accessed 1 October 2020].



Design Ideas

- **Potato Peeler**
  - Forceps to provide tension on removed tissue
- **Shovel Scalpel**
  - Augmented scalpel with client preferred motion
- **Spiked Roller**
  - Series of wheels to provide tension

Design #1- Potato Peeler

- Guard above blade for safety
- Pushing mechanism
- Forceps can rotate to continue tension
- Requires surgeon to use both hands
- Not adjustable
  - Thickness and blade width
- Least feasible out of the 3
  - Most complicated
  - Difficult to fabricate

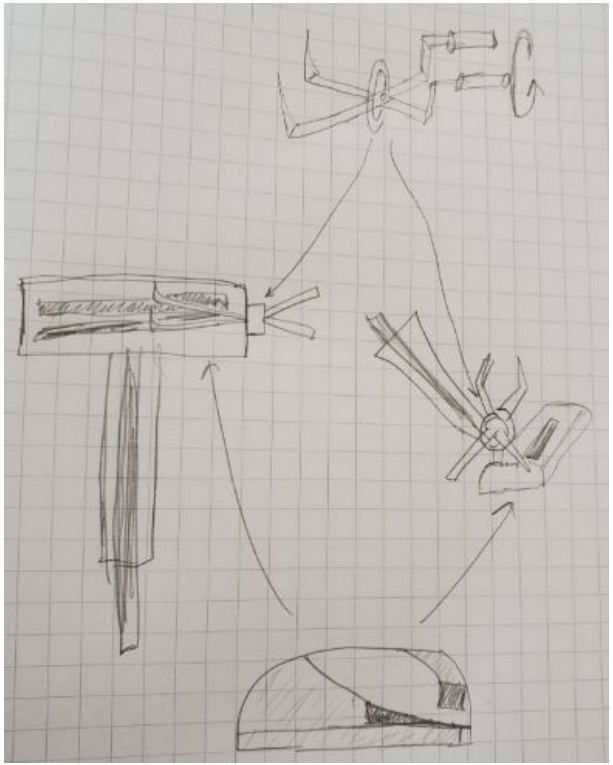
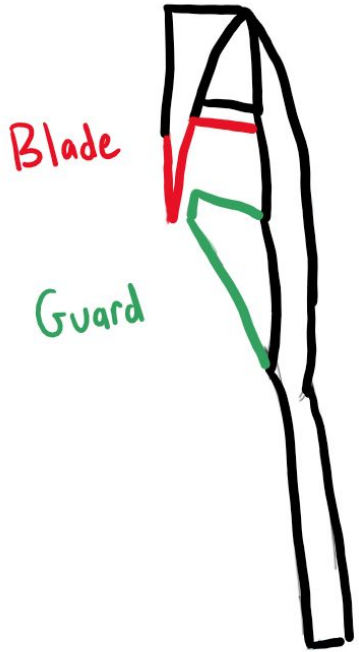


Figure 6: First draft of the Potato Peeler

Design #2- Shovel Scalpel

- Pulling motion favored by client
  - Easier motion
  - Must be validated with prototype
- Adjustable Guard in place to prevent thick sections
- Issues arise if cuts are too thin
  - Must be addressed by operating surgeon
- Doesn’t address issue of tension
  - Non-dominant hand responsible



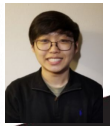
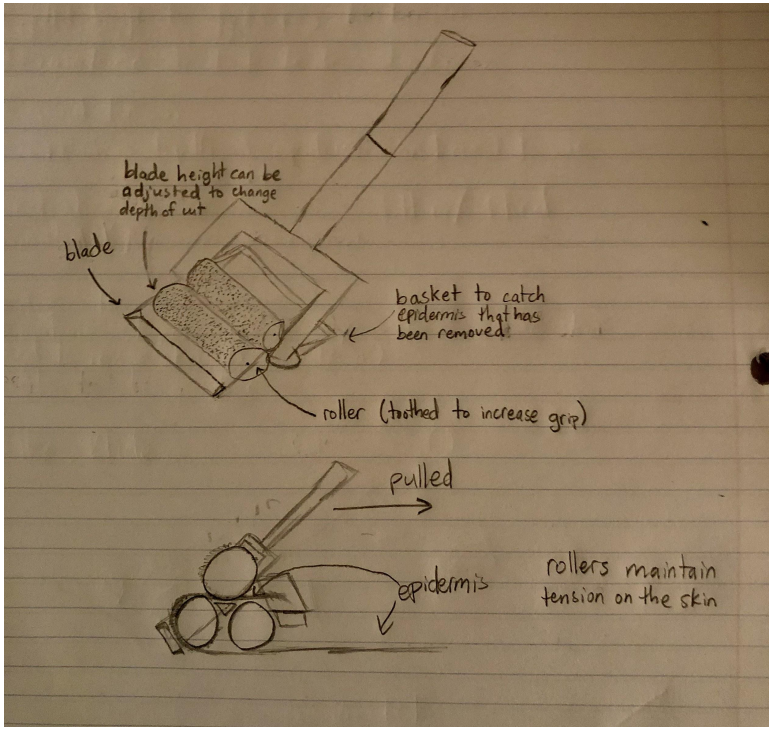


Figure 7: Shovel Scalpel

Design #3- Spiky Roller

- Utilizes a system of rollers with teeth
- Blade adjusted to a desired depth
- Issues arise if cuts are too thin
  - Must be addressed by operating surgeon
- Problems initializing removal
- Could tear skin, nullifying design
  - Very thin layer of skin ≈0.35mm



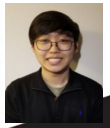
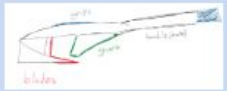
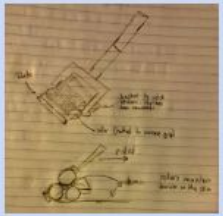


Figure 8: Spiky Roller

Design Matrix

	Design 1 Potato Peeler		Design 2 Shovel scalpel		Design 3 Spiked Roller	
						
Safety (30)	3/5	18	4/5	24	3/5	18
Efficiency (25)	4/5	20	4/5	20	4/5	20
Precision (20)	3/5	12	4/5	16	3/5	12
Feasibility (15)	1/5	3	4/5	12	2/5	6
Learning Curve (5)	5/5	5	5/5	5	3/5	3
Cost (5)	2/5	2	3/5	3	2/5	2
Total (100)	60		80		61	

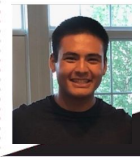


Figure 9: Design Matrix

Current Chosen Design

- Shovel Scalpel
  - Safest
  - Most Precise
  - Just As Efficient
  - Easy to Operate
  - Feasible and Cost Effective

	Design 1 Potato Peeler		Design 2 Shovel scalpel		Design 3 Spiked Roller	
Safety (30)	3/5	18	4/5	24	3/5	18
Efficiency (25)	4/5	20	4/5	20	4/5	20
Precision (20)	3/5	12	4/5	16	3/5	12
Feasibility (15)	1/5	3	4/5	12	2/5	6
Learning Curve (5)	5/5	5	5/5	5	3/5	3
Cost (5)	2/5	2	3/5	3	2/5	2
Total (100)	60		80		61	

Figure 9: Design Matrix

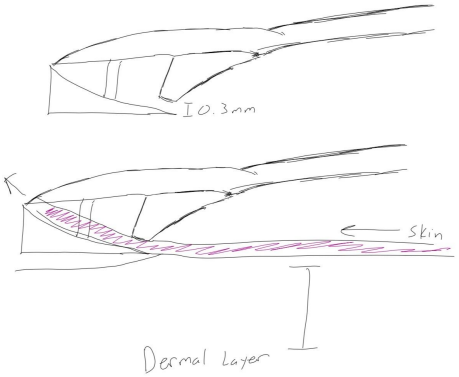


Figure 10: Shovel Scalpel

Foreseeable Problems

- Tension
- Prototyping
- Testing

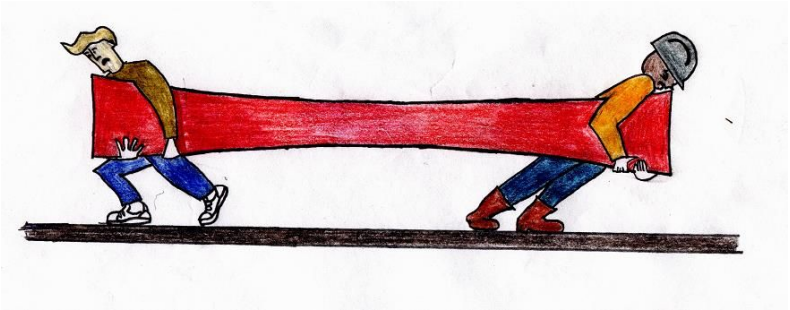
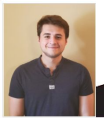


Figure 11: Two people creating tension

Figure 12: Manufacturing floor for medical devices



Future Work

Oct

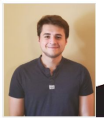
Finalize Design
Model prototype
Obtain testing material

Nov

Testing
Evaluating

Dec

Work with client for improvements for future semesters



Acknowledgements

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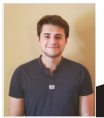
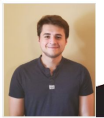
- Our clients, Dr. Carol Soteropulos, for proposing this project and providing input on different design ideas
- Our advisor, Dr. Krishanu Saha, for guiding us throughout the preliminary design process
- Our consultat, Todd Le, for providing assistance in meetings and design
- The BME Department, for providing us with the opportunity to work on this project



References

- [1] Current De-epping: T. O'Neill and P. Regan, “Button Holes: Novel Deepithelialization Technique in Reduction Mamaplasty,” *Oxford Academic*, 01-Mar-2011. [Online]. Available: https://academic.oup.com/asj/article/31/3/358/193829. [Accessed: 01-Oct-2020].
- [2] Important anatomy of the skin: W. Montagna and F. J. G. Ebling, “Pigmentation,” *Encyclopædia Britannica*, 01-Apr-2020. [Online]. Available: https://www.britannica.com/science/human-skin/Pigmentation. [Accessed: 01-Oct-2020].
- [3] MicroAire Surgical Instruments, LLC. 2020. *Microaire Epicut™ De-Epithelialization Device*. [online] Available at: <https://www.microaire.com/products/epicut/> [Accessed 1 October 2020].



Questions?