



Wound Edge Approximation

February 7, 2020

Client: Dr. Charlton

Advisor: Dr. Suarez-Gonzalez

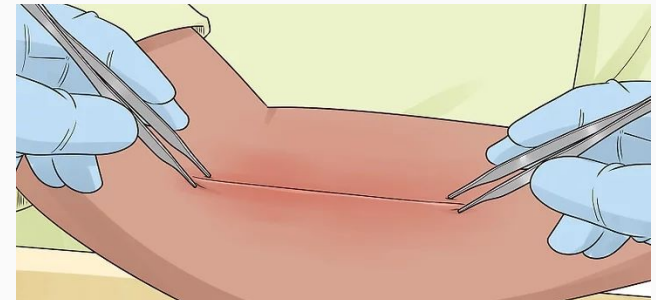
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Overview

- Background and Problem Statement
- Design Criteria
- Design Impact
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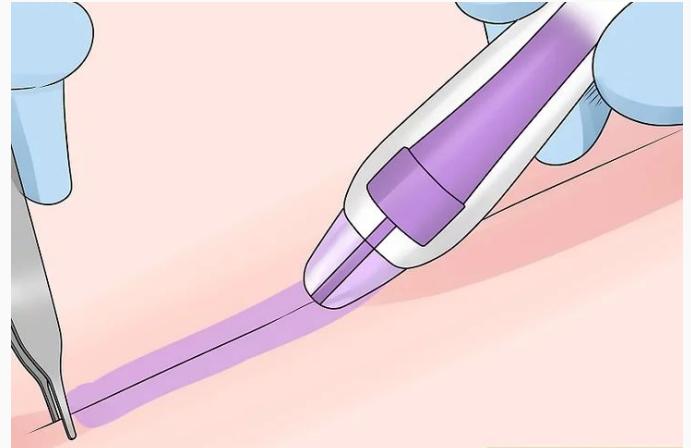
Background

- 6 million laceration cases treated each year [2]
- Wounds over 1-2 cm in size begin to splay
- Wound approximation - two margins of a cut are drawn together without gaps between the edges
- Imperfect approx. can lead to scarring and poor healing



Problem Statement

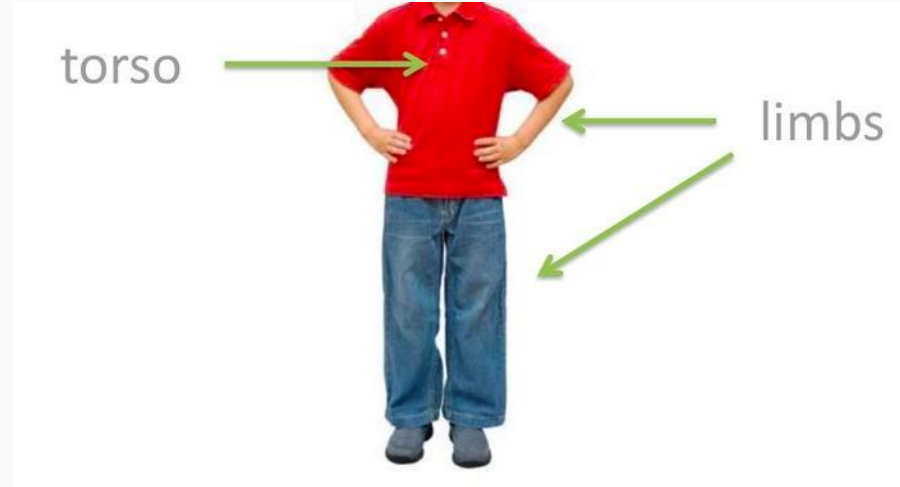
- Skin tension pulls edges of the wound apart
- Repair is difficult
 - Suturing or gluing
- Device to hold wound edges together while the wound is closed by clinician
- Device to be used with Dermabond [1]



<https://www.wikihow.com/Apply-Dermabond>

Design Criteria

- Use on limbs and torso
- Withstand sterilization (121°C) [3]
- Stay in place during approximation
- Must not cause pain
- 350 uses on 2-5 cm wounds
- Lightweight (<230 g)
- \$300 budget



Design Impact

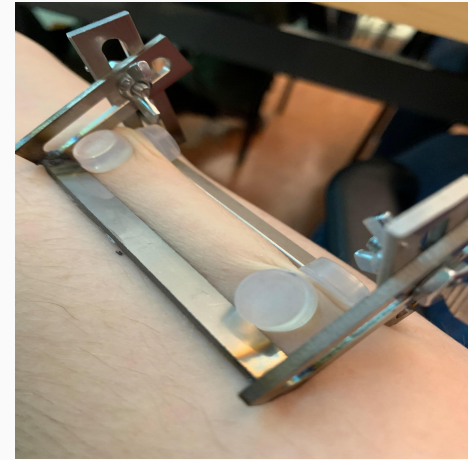
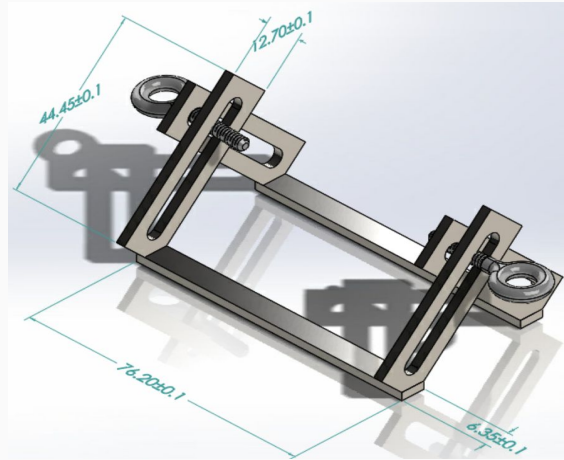
- Lacerations represent 10% of cases in emergency departments [4]
- Quick, easy method for physicians
- Reduces personnel needed for repair



<https://www.piedmont.org/living-better/first-aid-101-how-to-treat-a-cut>

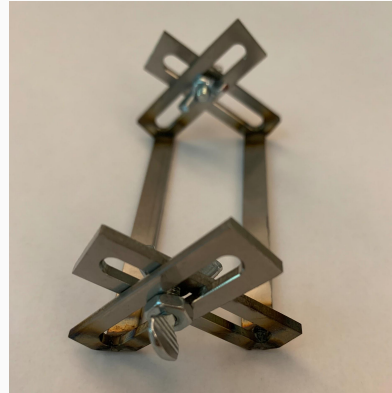
Current Prototype

- Adhesive silicone bumpers applied on corners of wound
- Edges of device placed around bumpers
- Wound approximated and thumb screws tightened to secure device in place
- Device remains in place while wound is repaired



Future Work - Fabrication and Design

- Redesign fastening mechanism
 - Current mechanism is clumsy
 - Implement spring mechanism
 - Hinge rather than slide
- Eliminate bumper system
 - Enhance device's adhesion to skin
 - Geckskin
 - Double-sided tape



Budget and Expenditures

Initial Budget:
\$300

Remaining Budget:
\$256.93

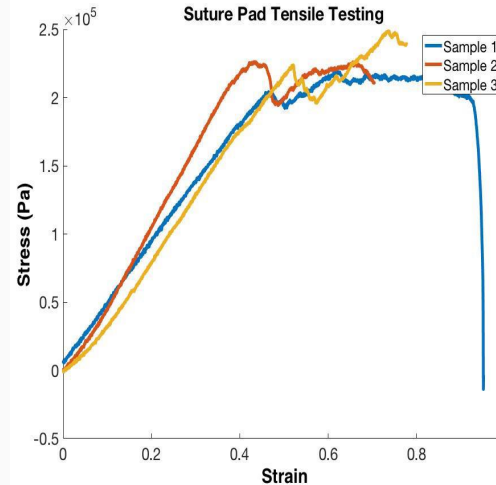
Expense Report:

Item	Quantity	Unit Cost	Extended Cost
Multipurpose Stainless Steel 304	1 Strip, 1" x 36" x 0.09"	\$18.38	\$26.22
GE Silicone 2+ Sealant Caulk	1	\$3.77	\$3.77
Waterjet Cutting at Makerspace	N/A	\$2.53	\$2.53
Sontax 96pc. 1/2" Clear Bumpers	Pack of 96	N/A	\$8.79
Thumb Screws #6-32 x 1/2	2	\$0.39	\$0.78
Zinc Plated Wingnuts	Pack of 6	N/A	\$0.98
Total			\$43.07

Initial Testing

Methods

- Force required for wound approximation
 - MTS tensile data of suture pad
 - Calculate force from skin deformation
- Device displacement during service
 - SkinPrep and bare skin conditions
- Skin markings after use
 - Observe skin deformations from device
- Discomfort Scale
 - 0: no pain
 - 5: severe pain



Results

- Suture pad is not an accurate model of skin
- Insignificant displacement between conditions
- Light red markings on skin
- Minimal discomfort

Future Work - Testing

- Use a skin sample that mimics the properties of human skin
 - Skin tension forces between 6.5 and 7.8 N [5]
 - Anisotropic and viscoelastic
 - Silicone or polyurethane models [6]
- Solidworks mechanical modeling
 - Creep and stress relaxation
- Test on arms, legs, and torso
- Ease of use assessment with client



Semester Timeline

Task by Friday	February				March				April				
	7	14	21	28	6	13	20	27	3	10	17	24	
Research	Progress Made	Progress Made	Progress Made	Progress Made		S P R I N G B R E A K							
Device Fastener Fabrication			Progress Made	Progress Made	Completed								
Silicone/Adhesive Fabrication			Progress Made	Progress Made	Completed								
Finalize Testing Methods			Progress Made	Progress Made	Completed								
Order/Fabricate New Skin Alternative				Progress Made	Progress Made		Completed						
Testing							Progress Made	Progress Made	Progress Made	Completed			
Journal Report				Progress Made	Progress Made		Progress Made	Progress Made	Progress Made	Progress Made	Completed	Deadline	

Progress Made

Completed

Deadline

Acknowledgements

Client: Dr. Charlton

Advisor: Dr. Suarez-Gonzalez

Previous Team Member: Lizzy Schmida

References

- [1] Jnjmedicaldevices.com. (2019). *DERMABOND® Mini Topical Skin Adhesive | J&J Medical Devices*. [online] Available at: <https://www.jnjmedicaldevices.com/en-US/product/dermabond-mini-topical-skin-adhesive> [Accessed 18 Sep. 2019].
- [2] Quinn, J., Polevoi, S. and Kohn, M. (2013). Traumatic lacerations: what are the risks for infection and has the 'golden period' of laceration care disappeared?. *Emergency Medicine Journal*, 31(2), pp.96-100.
- [3] CDC.gov. (2008). *Steam Sterilization: Guideline for Disinfection and Sterilization in Healthcare Facilities*. [online] Available at: <https://www.cdc.gov/infectioncontrol/guidelines/disinfection/sterilization/steam.html>.
- [4] Hcup-us.ahrq.gov. (2019). [online] Available at: <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb156.pdf> [Accessed 10 Dec. 2019].
- [5] Omar E Beidas, Jeffrey A Gusenoff, Deep and Superficial Closure, *Aesthetic Surgery Journal*, Volume 39, Issue Supplement_2, April 2019, Pages S85–S93.
- [6] Dąbrowska, A., Rotaru, G., Derler, S., Spano, F., Camenzind, M., Annaheim, S., Stämpfli, R., Schmid, M. and Rossi, R. (2015). Materials used to simulate physical properties of human skin. *Skin Research and Technology*, 22(1), pp.3-14.