

# Suture Pullout in Human Cadaveric Skin: Evaluation of HEMIGARD® Augmentation Versus Suture Alone

Jacob Pearson, DO; Shaun Conley, DO; Olivia R Pipitone, MPH; Jason Lin, MD

## BACKGROUND

In 1861, Karl Langer described lines of tension over the skin that would ultimately guide surgeons to make incisions such that skin tension would be minimized<sup>1</sup>. Recently, there have been many efforts to optimize wound closure, many of which focus on augments which reinforce the closure. For example, polyethylene film application and suture passed through Steri-Strip™ have been reported to aid in laceration, large biopsy site, and advancement flap closure<sup>2,3,4</sup>.

Closure of high-tension surgical wounds is a challenge frequently encountered during surgical procedures. The use of a novel adhesive augmentation device, HEMIGARD®, has been proposed to decrease tension on wound closure and thereby increase the amount of force needed for suture pullout. In principle, this may help prevent wound dehiscence, skin edge necrosis, and the sequelae thereof.

## HYPOTHESIS

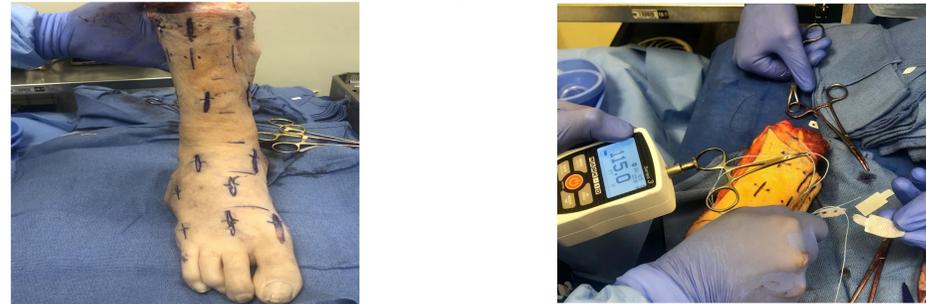
We hypothesized that HEMIGARD® augmentation of suture placement would require more force for suture pullout from human cadaveric lower extremity skin when compared to suture alone.

## METHODS

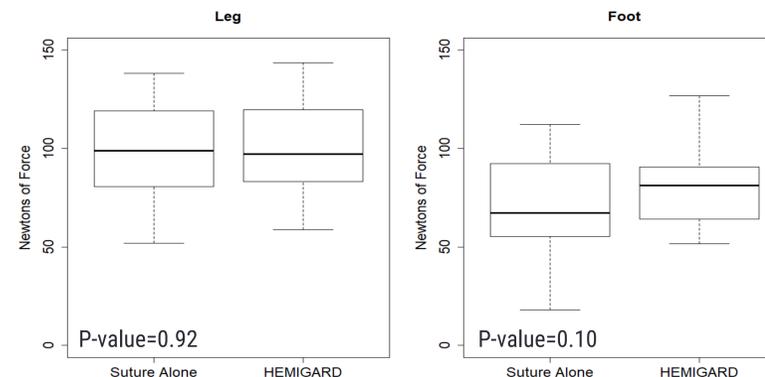
- HEMIGARD® with suture was compared to suture alone on leg and foot measurements from four cadavers.
- One side of the incision was used to test the HEMIGARD®. The other side of the same incision was used to test the same suture material, passed without HEMIGARD®, to allow for direct comparison.
- A force gauge was used to measure the Newtons of force required for suture pullout. A total of 30 measurements were recorded per cadaver; 15 using HEMIGARD® and 15 using suture alone.
- Due to repeated measures on four cadaver study subjects, we used linear mixed effects analysis. Leg and foot measurements were modeled separately. Treatment group was included as a fixed effect and there were random intercepts by cadaver subject. P-values are from likelihood ratio tests, which compared a model with the respective effect of interest against an identical model without the effect of interest.

## RESULTS

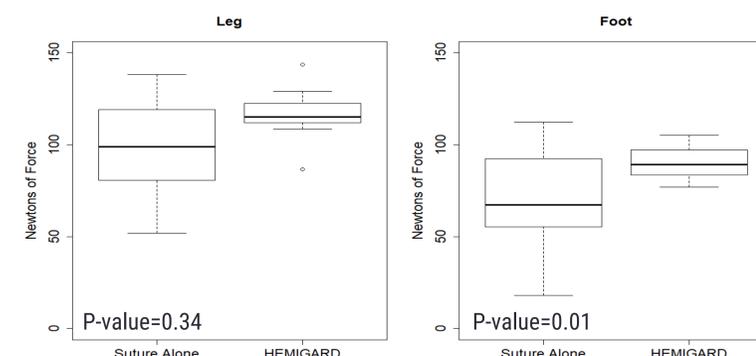
**Figure 1: Image of cadaver leg with incisions used in study and image showing Force Gauge used along with HEMIGARD® strip**



**Figure 2: Peak tension force required for suture pullout between HEMIGARD® and suture alone in cadaver leg and foot.**



**Figure 3: Out of the 24 HEMIGARD® leg measurements, there were 17 adhesive failures (71%), and out of the 36 HEMIGARD® foot measurements, there were 23 adhesive failures (64%). This figure shows peak tension force required for suture pullout between HEMIGARD® and suture alone in cadaver leg and foot measurements when excluding adhesive failures.**



## CONCLUSIONS

- The amount of force required for suture pullout from human cadaveric lower extremity skin did not significantly differ when using HEMIGARD® augmentation of suture placement versus using suture alone.
- However, when excluding instances of HEMIGARD® adhesive failure, the HEMIGARD® may be superior to suture alone in the cadaveric foot, but not in the cadaveric leg.

## FUTURE IMPLICATIONS

- Given the number of adhesive failures noted, application of HEMIGARD® to living tissue could prove critical to its proposed function. Future studies may benefit from the application of alternative skin preparations such as alcohol or liquid medical adhesive.
- The main limitations of our study are the use of an in vitro cadaveric model and small sample size. Specifically in our study, proper preparation of the cadaveric tissue is likely critical given chemicals used for tissue fixation not encountered during in-vivo surgical closure. Future studies should include an a priori power analysis to ensure a large enough sample size is utilized to adequately power statistical analysis.

## REFERENCES & ACKNOWLEDGEMENTS

1. On the anatomy and physiology of the skin. I. The cleavability of the cutis. (Translated from Langer, K. (1861). Zur Anatomie und Physiologie der Haut. I. Über die Spaltbarkeit der Cutis. Sitzungsbericht der Mathematisch-naturwissenschaftlichen Classe der Kaiserlichen Academie der Wissenschaften, 44, 19.). Br J Plast Surg. 1978 Jan;31(1):3-8. PMID: 342028.
2. Lipnik MJ. A novel method of skin closure for aging or fragile skin. Cutis. 2015 Oct;96(4):260-2. PMID: 26682288.
3. Davis M, Nakhjjevani A, Lidder S. Suture/Steri-Strip combination for the management of lacerations in thin-skinned individuals. J Emerg Med. 2011 Mar;40(3):322-3. doi: 10.1016/j.jemermed.2010.05.077. Epub 2010 Sep 29. PMID: 20880653.
4. Pacifico MD, Teixeira RP, Ritz M. Suturing of fragile skin. J Plast Reconstr Aesthet Surg. 2009 Dec;62(12):e637-8. doi: 10.1016/j.bjps.2008.11.091. Epub 2009 Apr 25. PMID: 19394907.