Silk Fibroin Wound Dressings

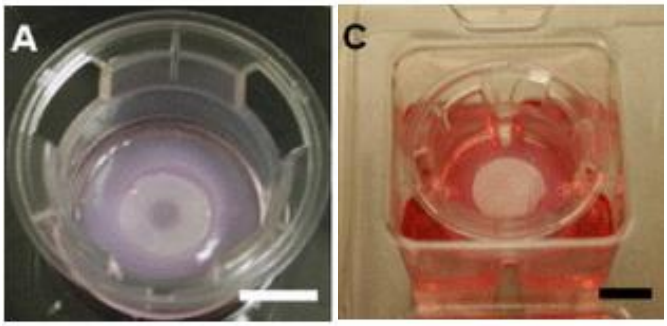
Sierra Obi, *Biomedical Engineering, University of Rhode Island.32*
BME 181 Second Presentation, March 30, 2013 <sierraobi@my.uri.edu>

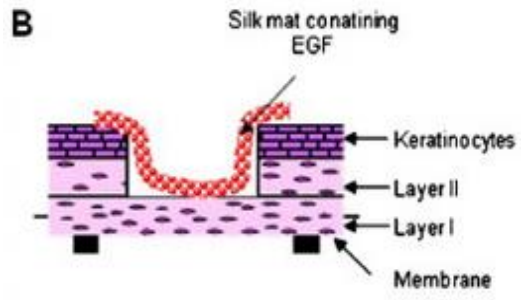
***Abstract*—Using a silk protein biomaterial, tissue engineers work towards creating a new therapy that will help cutaneous wounds. The silk biomaterial has proven to be a very effective way to address the issue of these wounds.**

I. Introduction

Several millions of people suffer from contaneous wounds. These wounds are difficult to heal, leave scarring, and are extremely prone to infections. Contaneous wounds are considered, however not limited to, severe burns, deep tissue animal bites, skin tears and wounds caused by cutting or piercing instruments. There are numerous wound dressing biomaterials on the market today that deal with the problem however, the issue is that they are still taking quite a significant amount of time to heal the wounds. With the discovery of using silk protein as a biomaterial, engineers are creating new ways to deliver the therapies to the area of the wound. These silk protein derivatives are being tested against an air permeable and a commercial wound dressing product made by 3M ™.

II. Methods





A silk fibroin derivative is tested on a full thickness skin wound model or an in vitro human skin model. In the most current experiments, the full thickness skin wound model has been tested on rats to compare the behavior of a wound under the conditions of the silk protein and the conditions of the 3M ™ products. Three different designs of silk proteins and two different types of drug incorporation. The silk proteins used were lamellar porous silk films, electrospun nanofibers, and silk mats. The two types of drug incorporation used were coating and loading. The difference in the two is that coating is when a layer of the drug was put over the proteins and loading was injecting them so the protein would carry them to the wounded site. Using *in vivo* epidermal growth factor (EGF) the release of signal molecules was controlled.
and silver sulfadiazine sufficient.

III. Results

After 12 days, all wounds covered with the silk biomaterials showed a regenerated dermis and a concurrent epithelium with several viable layers. In the fibroblasts that contained the drug coated silk biomaterials, there was ingrowth of capillaries. About 5 weeks after wounding, the all wounds were visualized to have a significant improvement. However, the area of the wounds covered with the silk biomaterials and Hydrocolloid dressing appeared smaller. The shape of the wounds with the silk biomaterials were rounder in shape where the empty wounds were an elongated shape.

Table 1. Changes in wound sizes with silk biomaterials and Hydrocolloid (3M).

		Wound Size (%)			
Samples	**Functionalization**	**Day 3**	**Day 6**	**Day 9**	**Day 12**
Film	No Drug	92 ± 21	53 ± 14*	29 ± 27*	13 ± 13*
	Drug Loaded	107 ± 5	66 ± 16*	43 ± 5*	20 ± 4*
	Drug Coated	92 ± 25	45 ± 7*#	24 ± 14*	9 ± 9*
Lamellar Film (porous)	No Drug	89 ± 6*	52 ± 2*#	32 ± 1*	17 ± 4*
	Drug Loaded	71 ± 11*	56 ± 4*#	34 ± 17*	14 ± 11*
	Drug Coated	74 ± 14*	46 ± 2*#$	26 ± 3*#	9 ± 5*
E-spun Mat	No Drug		66 ± 10*		5 ± 1*
	Drug Loaded		53 ± 4*#		6± 1*
	Drug Coated		48 ± 12*#		5± 1*
Empty[a)]		115 ± 12	99 ± 3	69 ± 17	29 ± 5
+ Control (Hydrocolloid, 3M)			67 ± 5*		10 ± 8*

a) [a)]Empty wound sites were covered with air-permeable Tegarderm (3M) tape, while the other sites were covered with a silk patch or Hydrocolloid patch (control) and then Tegarderm (3M) tape.
*$, *#$, *#* indicates statistical significance between means of sample group and empty group at same time points ($p < 0.05$, N = 3 Mean ± SD).
*#$, *# # indicates statistical significance between means of drug-functionalized group and no-drug group at same time points ($p < 0.05$, N = 3 Mean ± SD).
*$, *#$ $ indicates statistical significance between means of sample group and +control (Hydrocolloid) group at same time points ($p < 0.05$, N = 3 Mean ± SD).

IV. Discussion

The silk fibroin hydrocolloid dressing did decrease the wound sizes the most within the experiment however is was the lamellar porous silk films that produced the most efficient results when compared the wounds covered by the commercial tape and wound dressing. This method is in its early stages of testing and is currently tested on rats. No dates have yet been set to run clinical trials. Although, the silk fibroin has proved to be a very promising biomaterial for its versatility.

References

[1] http://onlinelibrary.wiley.com/doi/10.1002/adhm.201200444/full
[2] http://www.sciencedirect.com/science/article/pii/S1742706108004054
[3] http://www.nejm.org/doi/full/10.1056/NEJMra0707253