LIGHT-ACTIVATED SEALING OF SKIN WOUNDS

N.Xu, M.Yao, W.Farinelli, Z.Hajjarian, Y.Wang, R.W.Redmond, I.E.Kochevar
Massachusetts General Hospital, Aura Medsystems
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Objectives. A light-activated photochemical tissue bonding (PTB) were developed for rapidly sealing skin surgical wounds. The goals of this study were to evaluate parameters influencing PTB in order to optimize its clinical efficacy and to determine whether PTB can be used to seal wounds in moderately to highly pigmented skin.

Materials and Methods. The Rose Bengal (RB) followed by exposure to 532 nm light was used to seal linear incisions (1.5 mm deep, 2 cm long) in lightly pigmented (Yorkshire) and darkly pigmented (Yucatan) swine skin. The force required to open the seal was measured by *in situ* tensiometry. Reflectance spectra, epidermal transmission spectra, and histology were used to characterize the skin. The relationships of RB concentration and fluence to bonding strength were established in Yorkshire skin. Surface temperature was measured during irradiations and cooling was used while sealing incisions in Yucatan skin. Monte Carlo simulations were carried out to estimate the effect of epidermal melanin on the power absorbed in the dermis at the incision interface.

Results. The lowest fluence, 25 J/cm^2, substantially increased the bonding strength (10-fold) compared to controls in Yorkshire swine skin. Increasing the fluence to 100 J/cm^2 enhanced bonding strength by a further 1.5-fold. Application of 0.1% RB for 2 minutes produced the greatest bonding strength using 100 J/cm^2. Reflectance spectra indicated that Yucatan swine skin was a good model for highly pigmented human skin. In Yucatan skin, the bonding strength increased 1.7-fold using 0.1% RB and 200 J/cm^2. Monte Carlo simulation indicated that absorption of 532 nm light by epidermal melanin in dark skin decreased the power absorbed by a factor of 2.7.

Conclusions. In lightly pigmented skin the PTB time can be shortened without compromising the bonding strength. Sealing incisions in moderately or highly pigmented skin requires a balance of irradiance and cooling.