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The ablative fractional coagulation zone influences skin fluorescence intensities of topically applied test molecules-An in vitro study with fluorescence microscopy and fluorescence confocal microscopy.

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ABSTRACT

BACKGROUND: Ablative fractional laser (AFL) increases uptake of topically applied skin agents. The coagulation zone (CZ) surrounding vertically ablated channels may influence uptake of drugs.

OBJECTIVES: To investigate impact of CZ thickness on skin fluorescence intensities (FI) of a hydrophilic molecule by means of fluorescence microscopy (FM) and fluorescence confocal microscopy (FCM). Second, to compare FI of hydrophilic and lipophilic test molecules by FCM.

STUDY DESIGN/METHODS AND MATERIALS: Microchannels with CZ thicknesses of 0, 20, and 80 μm were generated by microneedles or AFL (10,600 μm). Channels were 700 μm deep and number of channels kept constant per skin area. After 4 hours of incubation, FI induced by sodium fluorescein (NAF, hydrophilic, logarithmic partition-coefficient ($\log P$) = -1.52, MW = 376.26) were quantified in both CZ and surrounding skin by FM (0-1,500 μm) and FCM (0-90 μm). FI of NAF and carboxyfluorescein (CAF, lipophilic, $\log P$ = 2.9, MW = 376.32) were compared by FCM.

RESULTS: By FM, NAF-induced FI were higher in CZ than in surrounding skin ($P < 0.001$). Highest NAF-FI were induced in skin pretreated with a thin CZ (CZ-20 μm), assessed by both FM and FCM and in particular, FI were higher than in skin pretreated with no CZ (CZ-0 μm) (FM $P < 0.041$, FCM $P < 0.012$). Skin FI remained constant to a depth of 500 μm , which corresponded to approximate depth of microchannels (CZ-0 μm , CZ-20 μm , CZ-80 μm : 0-500 μm $P > 0.107$). In accordance with FM data, FCM showed higher FI within CZ than in surrounding skin, but gradually decreased to zero at a depth of 90 μm . NAF-FI were higher than CAF-FI ($P < 0.036$), and highest CAF-FI were induced by CZ-0 μm and CZ-20 μm compared to CZ-80 μm ($P < 0.009$).

CONCLUSIONS: The influence of the CZ thickness on skin FI differs between small hydrophilic and lipophilic test molecules. Results may have clinical relevance for laser-assisted drug delivery. *Lasers Surg. Med.* © 2018 Wiley Periodicals, Inc. © 2018 Wiley Periodicals, Inc.

KEYWORDS: carboxyfluorescein; dermatology; drug delivery; reflectance; skin imaging; sodium fluorescein PMID: 30584842 DOI: 10.1002/lsm.23034