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?nm). 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 (logP)?=?-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, logP?=?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.

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