Enhanced Uptake of 10% Ascorbic Acid After 1440-nm or 1927-nm Non-ablative Fractional Diode Laser Treatment

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OBJECTIVE

- To quantify uptake of 10% ascorbic acid following pretreatment with low-power 1440-nm or 1927-nm non-ablative fractional diode lasers (Clear + Brilliant® laser system; Solta Medical, Bothell, WA) with varying treatment densities

CONCLUSIONS

- In this ex vivo analysis, the greatest enhancement of 10% ascorbic acid uptake was seen with 1927-nm pretreatment at 320 MTZ/cm² and 1.0 W, compared to 1440-nm wavelengths at varying wattage and treatment densities
- This provides a foundation for clinical studies on laser-enhanced uptake of ascorbic acid and other topicals, which can allow clinicians to better understand the relationship between quantifiable uptake enhancement and patient-centered outcomes

SYNOPSIS

- The stratum corneum forms a vital protective barrier along the outer layer of the skin, but also prevents optimal uptake of topical formulations[1]
- Lasers can facilitate better penetration and absorption of topicals by disrupting the stratum corneum and tight junctions in the epidermis[2]
- Non-ablative lasers generally target dermal tissue and largely spare the stratum corneum, which minimizes overall thermal side effects and postprocedural recovery time, while fractionation further reduces postprocedural downtime[3,4]
- The relationship between topical uptake and laser device settings, such as wavelength, peak power, and spot density, must be quantified to optimize treatment benefits

METHODS

- Excised human abdominal skin samples of 500-µm thickness were pretreated with a 1440-nm laser with 80 microscopic treatment zones (MTZ)/cm² (1.2 W), 1440-nm laser with 320 MTZ/cm² (3 W), 1927-nm laser with 320 MTZ/cm² (1 W), or received no pretreatment (Table 1)

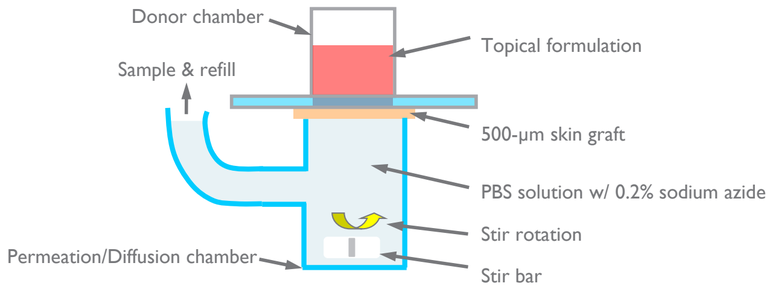
Table 1. Experimental Parameters

Parameter	Setting		
Device wavelength, nm	1440	1440	1927
Spot density, MTZ/cm²	80	320	320
Peak power, W	1.2	3	1
Spot size, µm	130	130	130
Pulse energy, mJ	9	9	9

MTZ, microscopic treatment zones.

- Following laser pretreatment, 10% ascorbic acid (Obagi®, Long Beach, CA; 2010 formulation) was applied, and permeation was measured up to 24 hours after application (Figure 1)
- Samples were filtered and analyzed using high-performance liquid chromatography to measure topical permeation and retention for laser-treated samples and untreated controls
- Total uptake was calculated as the sum of the normalized cumulative permeation and retention in each sample
- Average total uptake was compared between laser-treated samples and untreated controls to determine the uptake enhancement ratio

Figure 1. Study design for testing uptake of topicals on skin tissue.



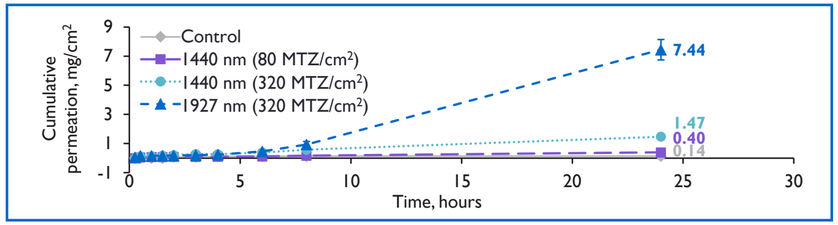
PBS, phosphate-buffered saline.

RESULTS

Permeation

- Pretreatment with the 1927-nm laser with 320 MTZ/cm² enhanced permeation of 10% ascorbic acid at 24 hours posttreatment relative to other pretreatments and untreated control (Figure 2)

Figure 2. Cumulative permeation of 10% ascorbic acid after laser pretreatment.



Values are mean ± standard deviation. MTZ, microscopic treatment zones.

Uptake

- Pretreatment with the 1927-nm laser with 320 MTZ/cm² enhanced uptake by >4 times compared to the 1440-nm laser with 320 MTZ/cm² (7.8 vs 1.8 mg/cm²; Table 2)
  - Compared to the 1440-nm laser with 80 MTZ/cm² (0.5 mg/cm²), uptake was enhanced by >15 times
  - Compared to untreated control (0.2 mg/cm²), uptake was enhanced by >33 times
- Pretreatment with the 1440-nm laser with 320 MTZ/cm² was associated with
  - >3-times greater uptake compared to the 1440-nm laser with 80 MTZ/cm² (1.8 vs 0.5 mg/cm²)
  - >7-times greater uptake compared to untreated control (1.8 vs 0.2 mg/cm²)

Table 2. Uptake Ratios of 10% Ascorbic Acid

	1440 nm (80 MTZ/cm²)	1440 nm (320 MTZ/cm²)	1927 nm (320 MTZ/cm²)
Control	2.18 ± 0.55 x	7.75 ± 2.02 x	33.61 ± 0.02 x
1440 nm (80 MTZ/cm²)	—	3.56 ± 0.70 x	15.45 ± 0.02 x
1440 nm (320 MTZ/cm²)	—	—	4.34 ± 0.07 x

Values are mean ± root mean square. MTZ, microscopic treatment zones.

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