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

**SYNOPSIS**

- The stratum corneum forms a vital protective barrier along the outer layer of the skin, but also prevents optimal uptake of topical formulations.
- Lasers can facilitate better penetration and absorption of topicals by disrupting the stratum corneum and tight junctions in the epidermis.
- 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.
- The relationship between topical treatment 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 (3 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).
- 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 topical permeation and retention for laser-treated samples and untreated controls.

**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).

**Table 1. Experimental Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device wavelength, nm</td>
<td>1440</td>
</tr>
<tr>
<td>Spot density, MTZ/cm²</td>
<td>80</td>
</tr>
<tr>
<td>Pulse power, W</td>
<td>1.2</td>
</tr>
<tr>
<td>Spot size, µm</td>
<td>130</td>
</tr>
<tr>
<td>Pulse energy, mJ</td>
<td>9</td>
</tr>
</tbody>
</table>

**Table 2. Uptake Ratios of 10% Ascorbic Acid**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Uptake Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1</td>
</tr>
<tr>
<td>1440 nm (80 MTZ/cm²)</td>
<td>2.18 ± 0.55 x</td>
</tr>
<tr>
<td>1440 nm (320 MTZ/cm²)</td>
<td>7.75 ± 2.02 x</td>
</tr>
<tr>
<td>1927 nm (320 MTZ/cm²)</td>
<td>15.45 ± 0.02 x</td>
</tr>
</tbody>
</table>

**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 1927-nm laser with 320 MTZ/cm² (0.3 mg/cm²), uptake was enhanced by >1.5 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:
  - 7.3-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).

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

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**References:**


**Disclosure:** JVW is an investigator for Solta Medical. PMF serves as an advisory and speaker board for Solta Medical. All and CF are employees of and may hold stock or stock options in Solta Medical. RGGC is an investigator and advisory board member for Solta Medical.

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