INTRODUCTION

During stone laser lithotripsy, some energy is absorbed by the medium through which the laser is fired. Prior studies have shown that temperature affects the energy absorption coefficient of water. We sought to evaluate the effect of irrigation temperature on renal stone ablation during superpulse thulium fiber laser (sTFL) lithotripsy.

METHODS

- Human kidney stones (36 stones) with the following compositions were each mounted on glass slides: Calcium Oxalate Monohydrate (COM)† (12), Calcium Oxalate Dihydrate (COD)‡ (12) and Uric Acid (UA)§ (12).
- Stones were divided into groups of 6 and then submerged into baths of 0.9% saline at either room temperature (20°C) or body temperature (37°C).
- At two locations on each stone, a 200 µm thulium laser fiber, in direct contact with the stone, was used to administer a single pulse (0.5 J, 1.25ms).
- The resulting cavitation and the volume of stone material removed by each laser pulse was analyzed using optical coherence tomography (Figure 1).
- The volume of stone removed at both temperatures of saline were compared using unpaired t-tests for each stone composition.

RESULTS

- For each stone type, there was a significantly greater mean volume of stone removed per laser pulse at 37°C than at 20°C saline (Table 1 and Figure 2). When fired in 37 °C compared to 20°C saline, a single pulse of the sTFL removed:
  - Calcium Oxalate Monohydrate: 11% more (p=0.034).
  - Calcium Oxalate Dihydrate, 6% more (p=0.007).
  - Uric Acid: 20% more (p=0.014).

<table>
<thead>
<tr>
<th>Stone Type</th>
<th>Mean Stone Volume Ablated (mm³)</th>
<th>Mean % Difference (95% CI)</th>
<th>p-Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Warm (37°C) N=12</td>
<td>Room Temperature (20°C) N=12</td>
<td></td>
</tr>
<tr>
<td>Calcium Oxalate Monohydrate†</td>
<td>0.173 ±0.023</td>
<td>0.151 ±0.024</td>
<td>0.014</td>
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<tr>
<td>Calcium Oxalate Dihydrate‡</td>
<td>0.193 ±0.038</td>
<td>0.138 ±0.052</td>
<td>0.014</td>
</tr>
<tr>
<td>Uric Acid§</td>
<td>0.097 ±0.021</td>
<td>0.073 ±0.022</td>
<td>0.014</td>
</tr>
</tbody>
</table>

*Significant at p<0.05
†Exact Composition: 90% Calcium Oxalate Monohydrate, 10% Calcium Phosphate
‡Exact Composition: 90% Calcium Oxalate Dihydrate, 10% Calcium Phosphate
§Exact Composition: 100% Uric Acid

CONCLUSION

the superpulse thulium fiber laser removes more stone material per single pulse energy when fired in body temperature (37°C) saline compared to room temperature (20°C) saline for calcium oxalate monohydrate, calcium oxalate dihydrate and uric acid stones.