MP15-12 ASSESSING THE IMPACT OF IRRIGATION TEMPERATURE ON SUPERPULSE THULIUM FIBER LASER LITHOTRIPSY WITH OPTICAL COHERENCE TOMOGRAPHY

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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℃) or body temperature (37℃).
- 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.

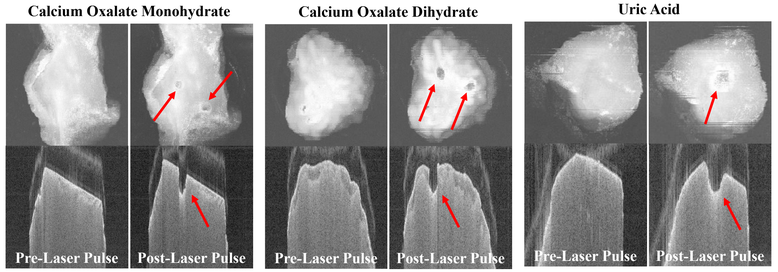

Figure 1: Optical Coherence Tomography (OCT) images demonstrating the stones before and after pulses of the sTFL laser. **Top Row** – OCT images showing stone surfaces and diameter of cavitation defects. **Bottom Row** – Single OCT cross section showing depth of cavitation defects. **Red arrows** – Cavitation defects where the laser was fired.

†Exact Composition: 90% Calcium Oxalate Monohydrate, 10% Calcium Phosphate
‡Exact Composition: 90% Calcium Oxalate Dihydrate, 10% Calcium Phosphate
⁂Exact Composition: 100% Uric Acid

RESULTS

- For each stone type, there was a significantly greater mean volume of stone removed per laser pulse at 37℃ than at 20℃ saline (Table 1 and Figure 2). When fired in 37 ℃ compared to 20℃ 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).

	Mean Stone Volume Ablated (mm³)			
Stone Type	Warm (37℃) N=12	Room Temperature (20℃) N=12	Mean % Difference (95% CI)	p-Value*
Calcium Oxalate Monohydrate†	0.173 ±0.023	0.151 ±0.024	11 [0, 22]	**0.034**
Calcium Oxalate Dihydrate‡	0.193 ±0.038	0.138 ±0.052	6 [12, 44]	**0.007**
Uric Acid⁂	0.097 ±0.021	0.073 ±0.022	20 [-1, 41]	**0.014**

Table 1: Mean Volume of Stone Removed by a Single Pulse of Thulium Laser Fiber in 37℃ and 20℃ saline.* *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

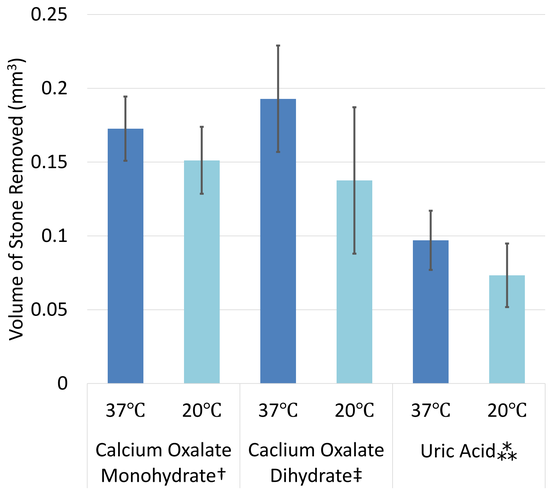

Figure 2: Mean Volume of Stone Removed by a Single Pulse of Thulium Laser Fiber in 37℃ and 20℃ saline. Error bars represent the standard deviation.

†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℃) saline compared to room temperature (20℃) saline for calcium oxalate monohydrate, calcium oxalate dihydrate and uric acid stones.

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