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Research In-Progress

Intraoperative Lens Cleaning Cannula for Laparoscopic Surgery

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Introduction: Surgeons performing laparoscopic procedures frequently encounter disruptions from lens obstruction due to blood, fogging, and fat debris. This necessitates repeated removals of the lens for manual cleanings, prolonging surgeries and blood loss. To address this, a modified laparoscopic cannula with an integrated saline port was designed for intraoperative lens cleaning, eliminating the need for repeat lens removals. The device includes a top-mounted saline port with a control valve which directs saline to the laparoscope to effectively clear debris and maintain optical clarity throughout the procedure.

Methods: The laparoscopic cannula prototype was fabricated using an Eisen CTL-618DT lathe and 6061-T6 aluminum. Validation involved simulating lens contamination with a blood mimic and testing cleaning efficacy with 5mL and 10mL saline volumes. Performance was measured with average flow rates of 3.2 mL/sec across fifteen trials for each volume. MATLAB code measured cleaning effectiveness by counting red pixels on the lens before and after cleaning, with red pixels indicating residual blood mimic.

Preliminary Results: MATLAB image analysis of the red pixel counts before and after cleaning indicate that there was less blood mimic residue left on the lens after cleaning to a statistically significant degree for both 5mL and 10mL volumes ($p<0.05$). Testing the prototype with various volumes of saline solution revealed that less than 10 mL of saline was needed, as 5 mL of saline was able to effectively restore visual clarity in under 3 seconds with the 3.2 mL/sec rate.

Next Steps: Future research will optimize the device's flow dynamics for better cleaning efficiency, assess its performance in clinical settings, and test it with fat debris and pressurized conditions to confirm broader applicability. Further development will refine the device for integration with existing laparoscopic systems and evaluate its impact on surgical outcomes.

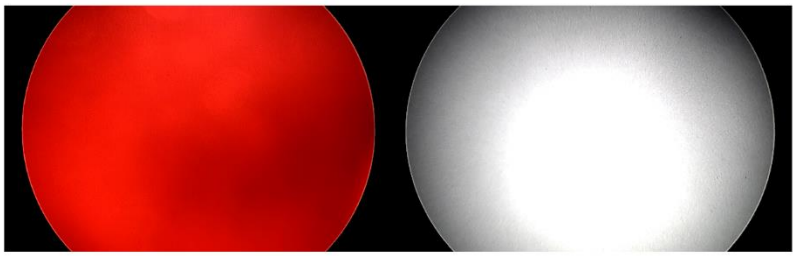

Figure 1. Images taken with laparoscopic lens before cleaning (left) and after cleaning (right) with the use of the laparoscopic lens cleaning cannula prototype from a 5mL saline cleaning trial