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# Catheter Attachment Device for Prevention of Urinary Tract Infection

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# CATHETER ATTACHMENT DEVICE FOR PREVENTION OF URINARY TRACT INFECTION

CAPSTONE DESIGN EXPO 2016

## Clinical Significance

Cather-associated urinary tract infection (CAUTI) is the leading hospital-acquired infection (HAI) in the U.S. Hospitals are often liable for these infections, so they can be very costly not only to the patient, but also to the hospital and care providers themselves. The Center for Disease Control and Prevention estimated the number of HAIs per year to be around 1.7 million, which contributes to 99,000 deaths each year. UTIs cause over 40% of HAIs, and over 80% of those UTIs are caused by urinary catheterization. With such a high percentage of inpatients (25%) being catheterized at some point during their hospital stay, it is essential to reduce the risk of infection by improving beyond the current standard of care.

The initial incident of infection typically occurs when a contaminant enters the urethral opening of the patient and allows a biofilm to form along the catheter tubing toward the patient's bladder. The risk of infection increases dramatically under several conditions: if the patient is female, incontinent, and catheterized for a long period of time, which all contribute to ease of fecal contaminants entering the urethral opening.

## Preliminary Design

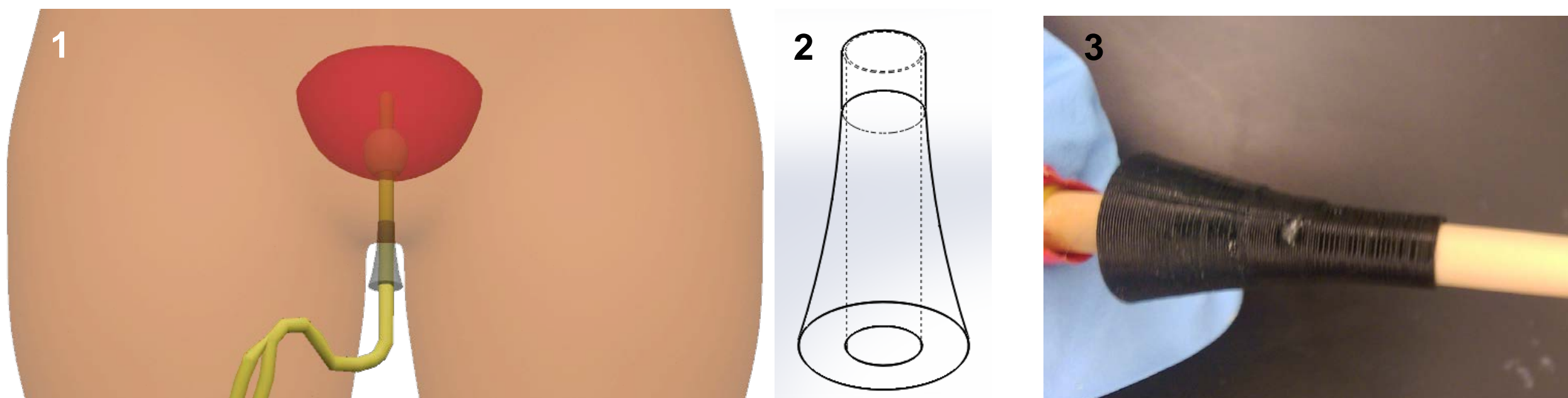


Fig. 1 – Concept drawing of the cone-shaped plug in place on a catheterized patient. [H. Huddle]  
 Fig. 2 – CAD model of the initial prototype, designed to fit onto a 14-French catheter.  
 Fig. 3 – 3D printed hard plastic prototype on a 14-French catheter.

## Final Design

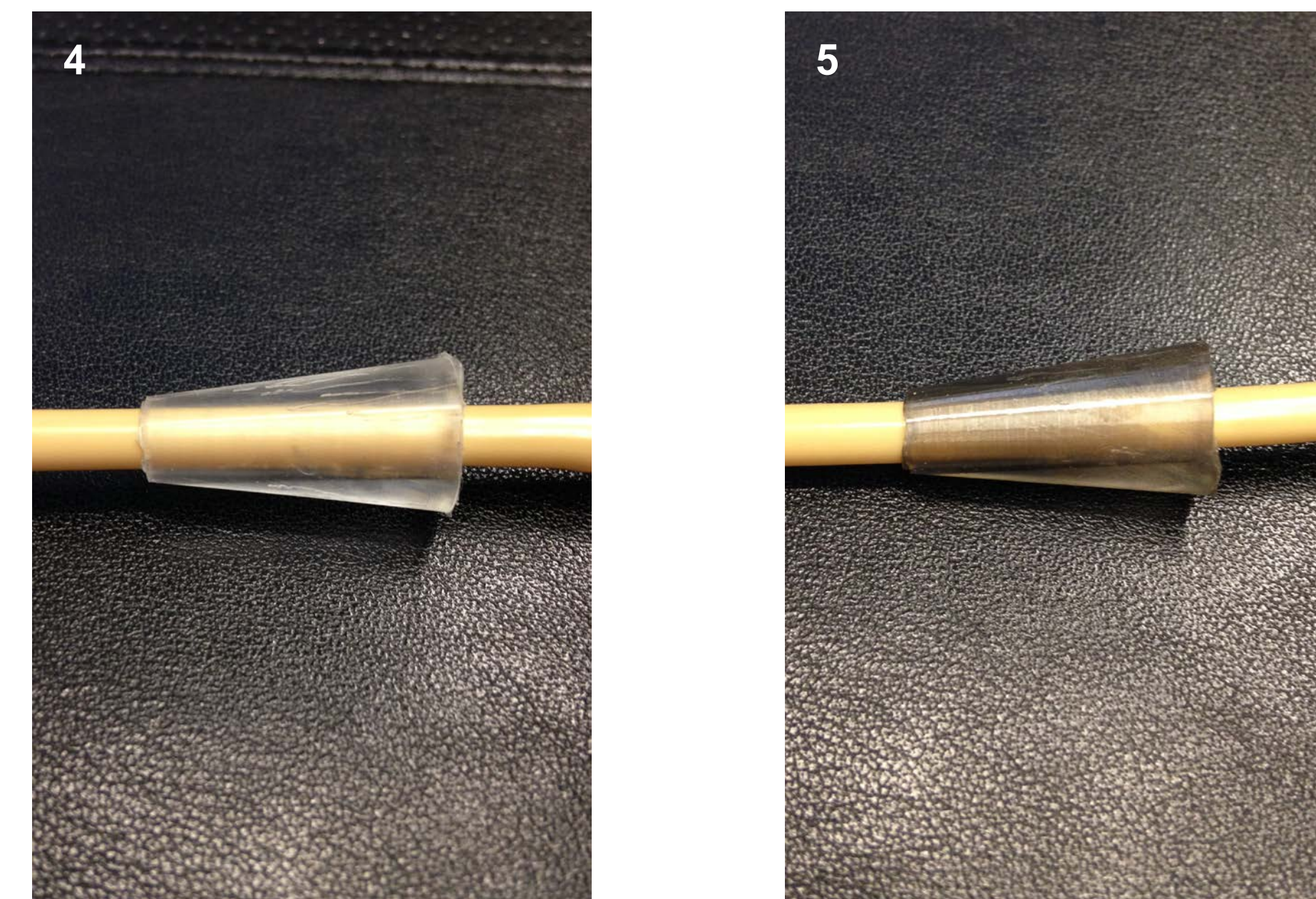


Fig. 4- Soft plug created using 1:13 blend of PDMS  
 Fig. 5- Soft plug created using 1:13 blend of PDMS with silver coating using plasma deposition

## Testing Methods

Two testing methods were created to validate the design of the device. First was a gross blockage of fecal matter migration using the 3D printed hard plastic device, a female anatomy model, and fecal simulant. Next, a device (box) was created for bacterial culture testing (figure 6) by 3D using PLA.



Fig. 6- 3D printed PLA box created for bacterial culture. Left side would receive L. broth and right side would be seeded with bacteria on agar gel.

## Testing Results

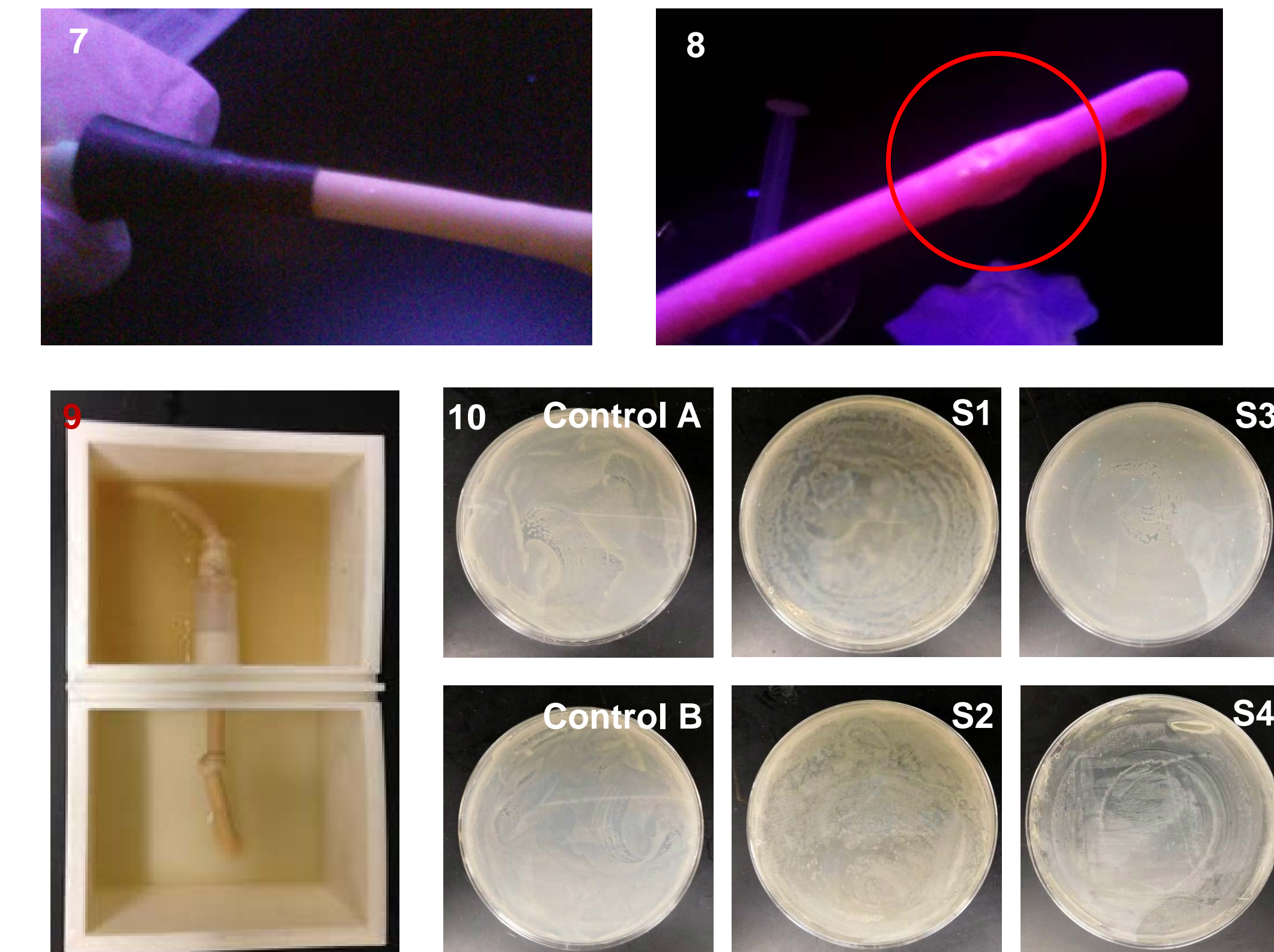


Fig. 7- Blocking testing of the plug. After removal of the catheter no fecal simulant was detected  
 Fig. 8- Control for blockage testing. Showed significant amount of fecal simulant upon removal of catheter.  
 Fig. 9- experimental set up for bacterial culture (100  $\mu$ L of  $8 \times 10^5$  CFU/mL E Coli)  
 Fig. 10- Bacterial culture results were inconclusive.

## Future Concerns

There are two main challenges to overcome in the future testing of this device

- 1) Create a smoother mold that will prevent tool mark striations in the soft polymer (figure 11).
- 2) Create a more reliable set up for bacterial culture that will not warp/distort after sterilization.

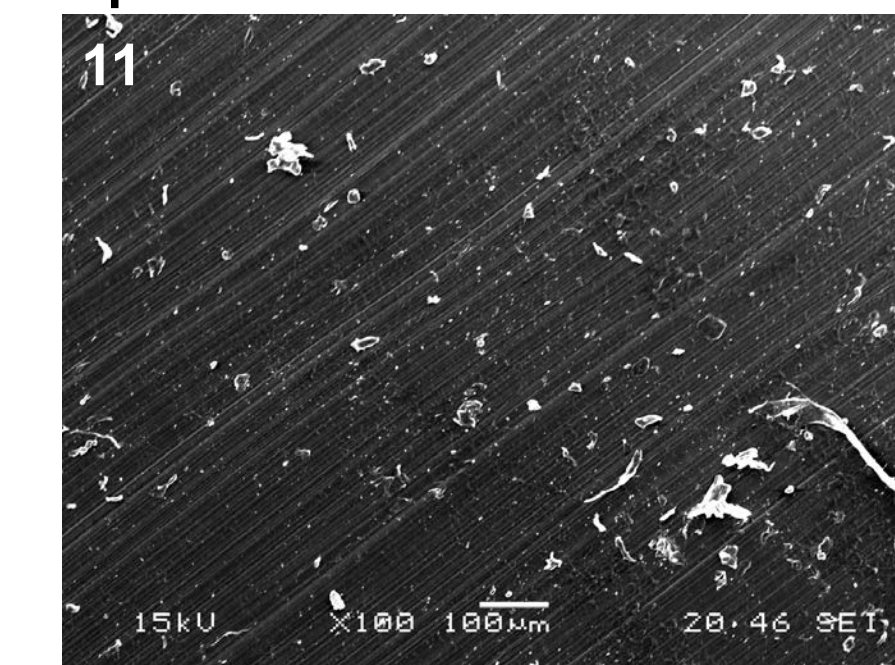


Fig. 11- SEM image at 100x showing striations in the PDMS plug due to machining of the mold.