College of Veterinary Medicine
University of Missouri

Novel surgical spoon for urolith removal during canine cystotomy

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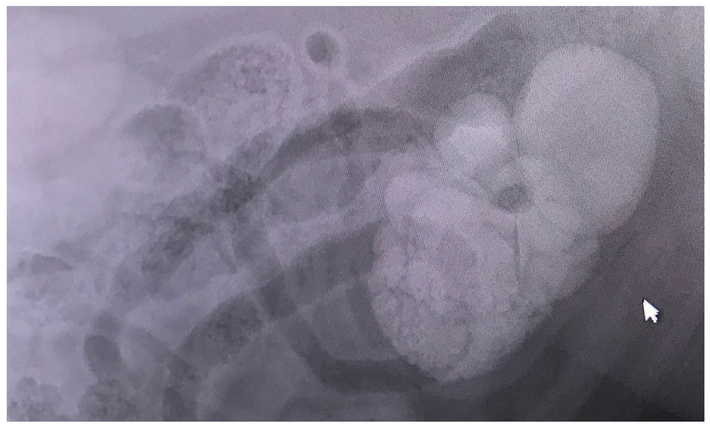
ABSTRACT

Cystotomy is commonly performed to remove uroliths from the urinary bladder, but retrieval of uroliths is limited to improvised use of available surgical instruments or off-label devices. Furthermore, there is an unacceptable incidence of incomplete urolith extraction, which can necessitate additional surgery and exacerbate morbidity. To improve urolith extraction, three novel 3D-printed surgical spoons underwent a clinical trial in Northwest Arkansas veterinary clinics. Postoperative questionnaires provided to those veterinarians recorded favorable experiences using one or more of the surgical spoons in two dogs weighing 23 to 34 kg. The most favored surgical spoon from the clinical trial underwent strategic design modification to evaluate in dogs weighing less than 20 kg. The resultant cystotomy spoon is a 12.5 cm shaft with a spoon on each end, one spoon narrower (1.4 cm at widest dimension) than the other (2.0 cm at widest dimension). The spoon will be manufactured into 304 stainless steel and enter a clinical trial at the University of Missouri Veterinary Health Center. Faculty surgeons and surgical residents will use the spoon during canine cystotomies and will complete a postoperative questionnaire to record expert opinion on the efficacy and usefulness of the spoon. We hypothesize that these surgeons will view the spoon as effective and user-friendly for urolith extraction during cystotomy. We anticipate that these surgeons may also have constructive input for design improvement. Once perfected, this surgical spoon will provide a specific device for canine.

ABDOMINAL RADIOGRAPHY OF UROLITHS

Below is an image of a canine abdominal radiograph taken at Faithful Friends Animal Clinic, Rogers, Arkansas.



INTRODUCTION

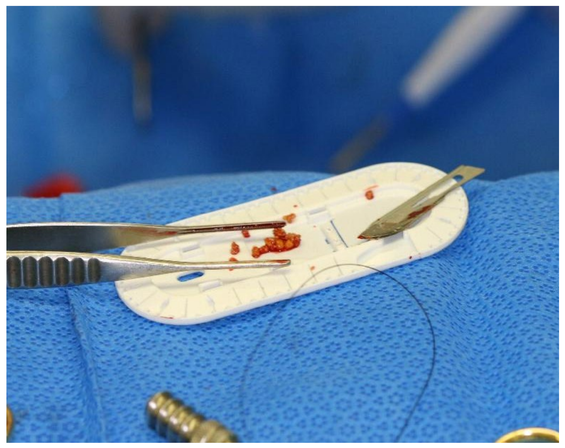
- Urolithiasis (urinary calculi, or uroliths) may occur in any part of the urinary tract. Struvite, calcium oxalate, and urate are the most common uroliths seen in dogs.
- Clinical signs of bladder uroliths include difficulty urinating (stranguria), blood in the urine (hematuria), discomfort, and potentially urinary obstruction.
- Abdominal radiography is useful for diagnosing urolithiasis if the uroliths are radiopaque. Radiolucent uroliths may require ultrasonography for diagnosis.
- Cystotomy (surgical incision into the urinary bladder) is performed to remove uroliths from the urinary bladder. Common methods for removing small uroliths are retrograde flushing and the use of off-label devices such as tablespoons, teaspoons, and gallbladder spoons. These spoons may push small uroliths toward the urethra making difficult visualization of remaining stones.
- Retained uroliths due to incomplete removal necessitate subsequent operation leading to potential postoperative complications and additional patient discomfort.
- To improve efficiency and effectiveness of urolith removal, three novel surgical spoons were strategically designed, and 3D printed at the University of Arkansas, to maneuver gently in the lumen and neck of the urinary bladder to extract uroliths that are migrating to the urethra.
- Clinical trials at two veterinary clinics in Northwest Arkansas demonstrated efficacy of urolith extraction during canine cystotomy. Favorable experiences were reported upon using the 3D-printed novel surgical spoon while performing cystotomy on a 23 kg mixed breed terrier and a 35 kg blue heeler.

OBJECTIVE

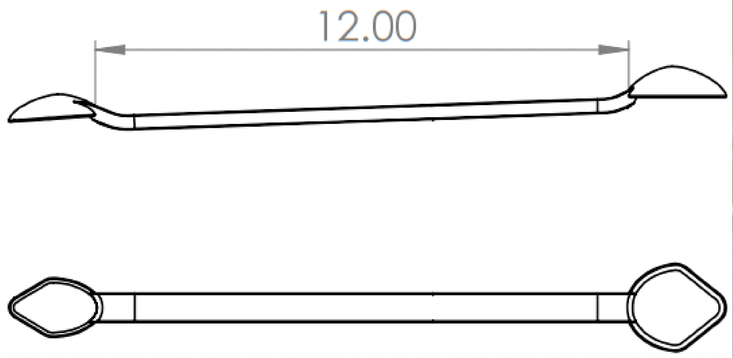
1. To modify the design and material of the current version of the canine cystotomy spoon.
2. To determine the efficacy of the final model through a clinical trial at the University of Missouri Veterinary Health Center.

CANINE UROLITHS

Below is an image of canine uroliths extracted during a cystotomy at the Veterinary Health Center, Columbia, Missouri.

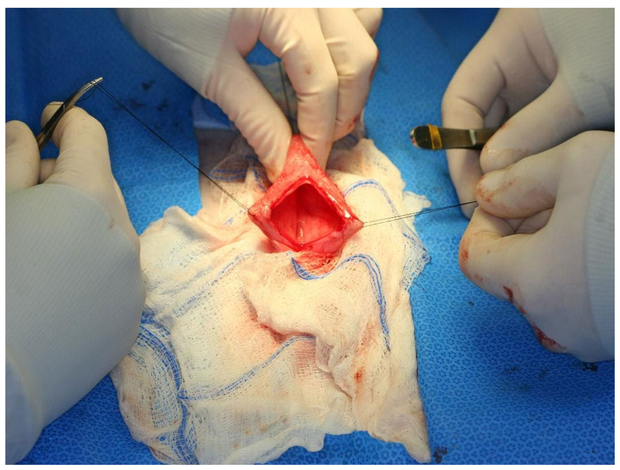


NOVEL CYSTOTOMY SPOON



CYSTOTOMY SURGERY

Below is an image of a canine cystotomy performed at the Veterinary Health Center, Columbia, Missouri.



Veterinary Research Scholars Program
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HYPOTHESIS

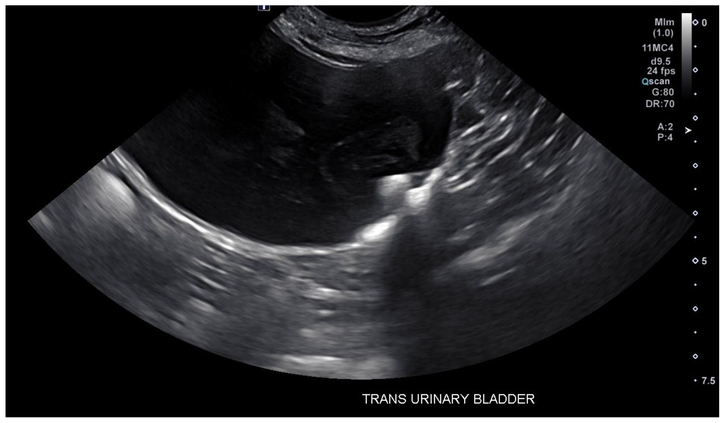
1. We hypothesize that the cystotomy spoon will be effective for removal of bladder uroliths in dogs weighing <11 kg (narrow end of the spoon) and in dogs weighing 12 to 25 kg (wide end of the spoon).
2. We hypothesize that surgeons at the University of Missouri Veterinary Health Center will rate the cystotomy spoon as user friendly.

MATERIAL AND METHODS

- Design modification on SolidWorks to improve access into urinary bladders of small dogs, maximize maneuverability, and access to the trigone of the urinary bladder.
- Physics Machine Shop at the University of Missouri will manufacture the cystotomy spoon into 304 stainless steel.
- All cystotomy spoons will be subjected to autoclave sterilization prior to surgery.
- The participants will be dogs currently in need of cystotomy that undergone a preoperative abdominal radiography for diagnosis and visualization of the urolith(s).
- Faculty surgeons and surgical residents will complete a postoperative questionnaire to collect appropriate findings on their experience with and the efficacy of the surgical spoon.
- Species, breed, age, body weight, diagnostic imaging evaluation, previous history, and composition of uroliths will be analyzed with the postoperative questionnaire results to determine possible correlations.
- Analysis of the postoperative questionnaire will determine if the novel surgical spoon was a useful method of urolith removal, user friendly for the surgeon, and appropriate for the patient's urinary bladder size.

ABDOMINAL ULTRASONOGRAPHY OF UROLITHS

Below is an image of an abdominal ultrasound performed at the Veterinary Health Center, Columbia, Missouri.



EXPECTED RESULTS

- Based on medical records from the Veterinary Health Center, we are expecting 11 to 27 canine cystotomies after a year of utilizing the novel surgical spoon.
- We anticipate positive responses on the postoperative questionnaire from veterinary surgeons.
- We anticipate that the cystostomy spoon will be effective in removing stones from the urinary bladder.
- We anticipate that surgeons will use additional extraction methods, such as manual extraction and retrograde flushing, to ensure complete stone removal.

FUTURE DIRECTIONS

Design modification and evaluation of the novel cystotomy spoon for cystotomies in cats and other species through clinical trials.

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