CaOx is the most common and most difficult stone to manage.
To prevent their recurrence, I rely on three principals.

**Step 1: Hire a reliable surgeon**

**Step 2: Over-achieve urine goals**

**Step 3: Image often = nonsurgical voiding**

We will look at each one in depth.
Step 1: Hire a reliable surgeon

Rapid recurrence, in weeks to months, is often due to incomplete surgical removal.
Step 1: Hire a reliable surgeon


David C. Grant, DVM, MS, DACVIM, Tisha A. M. Harper, DVM, MS, DACVIM, Stephen R. Werre, DVM

...20% had incomplete removal.

In a study performed at the Virginia Maryland College. For every five cystectomies performed, surgeons left stones in 1.
Intraluminal suture is another risk for recurrence. A study in 2008 determined that almost 10% of recurrent stones had a stone forming nidus of suture. This type of fixed particle growth would not have occurred if suture had not been exposed to the bladder lumen. We analyze a lot of stones at the MUC, and we see a lot of stones with suture nidus.
Let’s look at a case that demonstrates that catheters should not be passed from the bladder down and urethra and suture retention. This is a later X-ray from a 10-year-old female Pomeranian before cystotomy.
Here is the X-ray after cystotomy. The stones are gone but the dog was constantly straining.
When an oblique ventral dorsal view was evaluated, we see why. A stone was pushed into the urethra and lodged there.
The case was transferred to me and the stone was managed by laser lithotripsy and the fragments removed.
After removing the stone, I examined the urinary bladder. Suture was observed in the lumen.
This case is not unique. This ultrasound also shows suture in the bladder after cystotomy.
This ultrasound also shows suture unravelling in the bladder after cystotomy
Step 1: Hire a reliable surgeon

...suture = 9.4% of recurrent uroliths..

At the Minnesota urolith center we not only see suture, but the suture knots as well.
This demonstration of the reactivity of suture emphasizes the urolith forming potential of suture when placed in a concentrated sodium acetate solution.
Step 2: Over-achieve urine goals.

Step 2-over achieve urine goals.
Step 2: Over-achieve urine goals

Activate the recommendations tab for prevention strategies for calcium oxalate
This is what you will find. In addition to providing diagnostic and nutritional goals, we also provide goals for the urine to minimize recurrence.
WHY?

Why achieve these goals?
WHY DO DOGS FORM CaOx UROLITHS?

Let’s look at risk factors for calcium oxalate.
Calcium oxalate stones form because urine becomes oversaturated with calcium and oxalate. The graphs on the bottom of the slide show urine concentrations of calcium and oxalate in 6 miniature schnauzers with calcium oxalate urolithiasis in blue and values for normal beagles without uroliths consuming the same diet in green. The values indicate that excess urine calcium is the driving force for stone formation and not oxalate.
Excessive calcium excretion was consistent distinguishing feature in other studies. In this study published in 2004.
And in this study published in 2015
A consistent risk factor in dogs with CaOx uroliths is excessive urinary calcium excretion

GOAL → decrease urine calcium excretion.

Based on these findings, reducing urine calcium excretion is an important goal to prevent Calcium oxalate urolith recurrence.
Although the exact etiology of excessive calcium excretion and calcium oxalate uroliths is incompletely understood, we are aware of several controllable factors that should minimize recurrence, Salt, concentration urine and acidic urine.
RISK FACTORS CONTRIBUTING TO CALCIUM EXCRETION

Dietary salt
Salt and calcium share similar pathways for excretion and rely on one another in the process. This study in dogs shows that increasing dietary salt increases calcium excretion.
Added to this graph is the relative supersaturation of calcium oxalate. Salt also increases increased water excretion. Although RSS is reduced, more could be achieved if increase urine formation occurred without increasing calcium loss in urine.
This graph shows the effect of dietary salt and its ability to lower urine specific gravity. Increased salt lowers urine concentration, but
Not enough to reach our target range below 1.020. Therefore, even diets with the maximal salt would not be expected to do the desired job.
CaOx Prevention and the Story Behind Voiding Urohydropropulsion  
Author: Dr. Jody Lulich

Slide 29

<table>
<thead>
<tr>
<th>Food</th>
<th>Kibble or Canned</th>
<th>Sodium mg per 100 Kcal</th>
<th>Calcium mg per 100 Kcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purina UR St/Ox</td>
<td>Kibble</td>
<td>330</td>
<td>300</td>
</tr>
<tr>
<td>Royal Canin SO</td>
<td>Kibble</td>
<td>300</td>
<td>180</td>
</tr>
<tr>
<td>Royal Canin SO</td>
<td>Canned</td>
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<tr>
<td>Purina UR St/Ox</td>
<td>Canned</td>
<td>130</td>
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<td>Hills c/d mcare</td>
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<tr>
<td>Hills u/d</td>
<td>Kibble</td>
<td>52</td>
<td>75</td>
</tr>
</tbody>
</table>

When choosing a therapeutic food, consider the adverse effects of those with high sodium.
Concentrated urine is also a risk factor
This graph shows that foods with high moisture reduce calcium oxalate crystallization potential. The black bars show the values when canned food is consumed.
In this graph urine specific gravity is superimposed over the reduction in relative supersaturation.
Even with the additional water over dry, canned foods are unlikely to meet our goals for urine specific gravity and my suggestion is that even lower values are needed.
Consider adding water to kibble and canned food
Flooding the urinary tract is the safest and easiest and most effective way to decrease urinary concentrations of calculogenic minerals.
Although we provide a guide, lower values will be more effective.
What about urine pH
In a large retrospective study of first-time stone formers, acidic urine was a significant risk factor. Until we have better prospective studies to address this question, decreasing urine acidity is an additional protective measure to reduce recurrence.
Acids contribute to calcium loss by mobilization of minerals from bone as buffers, more ionized calcium is free to pass through the glomerulus. Acid urine may also alter mediators of calcium oxalate crystallization inhibitors.
Acidosis also inhibits transport processes at the renal tubules
We do not know all of the underlying mechanisms but, metabolic acidosis and aciduria increases urine calcium excretion and is, a risk factor for calcium oxalate. Test urine pH can and keep it more neutral. How do I do that? pH paper and potassium citrate. Many formulations of citrate contain cranberry supplements.
A study in humans indicates that the addition of cranberry would be the wrong thing to do.
Giving potassium citrate is good but, but giving the formations with cranberry may adversely affect your efforts.
In summary, to effectively prevent calcium oxalate uroliths reduce urine calcium by over achieving urine goals of low specific gravity and neutral urine.
Reduce salt content of diets
Promote neutral urine pH
Reduce urine concentration-add water
Step 2: Over-achieve urine goals

We have other information that may also help
For those that cannot follow your recommendations consider reducing calcium with thiazide administration.
Step 3: Medical Image often to void stones out and avoid surgery
Charlie and his owner Mrs. Fretag, a woman in her sixties are all that is left of the family. She is seeing me for the first time. This was his 3rd surgery to remove bladder stones she tells me. “I will not do this again.” He stops eating. The incision looks like Frankenstein. He licks at the incision, and the cone they put on his head is torture. Is there anything else we can do she asks me?

This is where I became very academic, but I should not have, Charlie is her child. I cannot guarantee that he will never have stone again, but I can guarantee that he never has surgery.
Take a good look at Charlie. He is very finicky, he eats what I eat. I can work with that I told her.
Come in a see me more often. If we catch it early, no surgery I promise you. How are we going to do that? She asks?
In 1993, I developed a technique to rapidly remove stones
I explained it to her, but I will show it to you.
Completely anesthetize the dog. Fill the bladder with saline. Lift the dog so that the spine is vertical. Express the bladder removing the saline and the stones
Here are all of the stones we removed.
The 9 month recheck was clean.
At 18 months-The not so good news and the good news. Stones are back, but we can remove them without surgery.
PERFORMING VOIDING UROHYDROPROPULSION
X-ray the dog to make sure all of the stones are small enough to pass through the urethra
Anesthetize the patient. There are many ways protocols. Intubation and general anesthesia are best.
Fill the bladder with sterile isotonic solutions
Lift the dog so that the spine is vertical
express the urinary bladder to remove all of the fluid and stones
Simple technique to solve a difficult and recurring problem
Medical Image often to allow non-surgical voiding of recurrent stones. This female dog had three recurrences in 5 years.
We performed voiding urohydropropulsion
And removed all of the stones
3 STEPS TO PREVENT RECURRENCES

2015  2016  2018

Step 1: Hire a reliable surgeon
(pseudorecurrence, suture nidus recurrence)

Step 2: Over-achieve urine goals
(specific gravity <<1.020, pH>6.5)

Step 3: Image often = nonsurgical voiding
(Every 9 months, initially)

To prevent their recurrence, I rely on three principals.
**Step 1: Hire a reliable surgeon**
**Step 2: Over-achieve urine goals**
**Step 3: Medical imaging often to avoid surgery and remove stones nonsurgically by voiding them out**
We will look at each one in depth
How did we manage Charlie
The not so good news and the good news
After being anesthetized, I filled the bladder, stood Charlie up, expressed the bladder and removed all the stones
Let me tell you the story behind the technique.
Here is the X-ray to prove it.
Charlie now peeps like a champ
THE STORY BEHIND VOIDING UROHYDROPROPSLION
About 30 years ago, a veterinarian in Northern Minnesota called me up. I have a client moving to Texas. They have a little dog that is urinating in the house. Instead of caring for it they want to euthanize it. What’s wrong with it, I ask.
See if they will let you give the dog to me instead.
There she is in my house. And the reason she looks like she is being admonished, is because I am admonishing her.
She not only pees in my house but poops in the house as well
Things finally settle down. She stops soiling my house. Then one day, and that is all it takes, things get turned upside down. My dogs come to work with me, and I have evening tickets to the symphony, but I was running late. I rush home. When I opened the car door, both dogs jump out at the same time, the larger one falls on the little one. The little one is dragging her leg. I will miss the symphony.
The next day her leg gets repaired. And after paying for the surgery and my mortgage on my recent home purchase, there is nothing left to pay for.
stone removal
Why do people form kidney stones, while dogs form bladder stones?

This where you come in. At the end of one of my seminars, someone asks.........I would like to know why dogs form stones in their bladders and people form them in their kidneys.
I do not know why so I made it up. It probably has to do with the way we peep.
I grew up in a household of men. I assumed everyone stood up to peep
Boy was I wrong. But even in woman, the spine is vertical, and the urethra is at the bottom.
Unlike dogs, where the spine is horizontal, and the bladder is low.
But I can change that. Not one person had an encouraging word to say. So I stopped telling them what I was planning. I left my dog in a cage all day so that her bladder would be full of urine. I anesthetized her with propofol, had my technician stand her up and then expressed her bladder. All the stones came out.
Here are my two dogs. They were great dogs.
Until one day, one of my elderly clients loses her dog to lung cancer. After the grieving, I nudged her and whispered in her ear, I have a dog for you. She said no, I am too old, and I do not want to think about what will happen to the dog when I die. I told her, “you will not live as long without a dog.” She agreed. I will come and look at her, but I will not take her home. Sure. You know how the story ends. She could not leave without the dog. Little bit died before her owner. She went out and got another dog.
Little-bit 2 did out lived her owner and would come to live with me. Wouldn’t you know it, she also had stones and was my first laser Lithotripsy patient. She would eventually move on to a new wonderful home, making room in mine for more needy dogs. (I did not know this but Little bit 2’s new owner lived in the same neighborhood as Lille bit 1. The new owner called me one day to tell me that every time she walks the dog, the dogs insisted on going up the stairs of her old house.) When she told me the address, I explained that was little bits first home.
What is the point?
You never know how far a simple act of kindness
That initial gesture not to euthanize that dog from Northern Minnesota dog became so much more.
Voiding urohydropropulsion was invented
Laser lithotripsy advanced
Lorene Herman lived out her full life
Charlie peeps like a champ
And each year hundreds of dogs benefit from a simple flushing technique to non-surgically remove their stones.