Update on Chronic Stomatitis
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Introduction: So our next lecture is also by Dr. Peralta. It's an update on chronic stomatitis. If you were not here for the first lecture, Dr. Peralta is a diplomate in the American Veterinary Dental College, currently appointed as Clinical Assistant Professor and is the Chief and Residency Director of the Section of Dentistry and Oral Surgery here at Cornell University.

Dr. Peralta: Thank you. Okay, so I'll try to be better with the time this time. So let's get started. I'm actually going to talk mostly about chronic stomatitis, of course. But at the very end, I have a few slides on tooth resorption, which somebody already asked me about it. And I thought it was important, because tooth resorption is also a very common dental pathology that you guys probably see every week. So we'll touch on that, too.

So the objectives for this first part of this lecture will be to review the clinical pathological aspects of chronic stomatitis, at least what we know about it, reveal the possible causative mechanisms of the disease and to go over the basic diagnostic and treatment strategies, for it is a very frustrating and horrible disease.

So to get started, clinical pathological aspects, we should start by defining a few things. Gingivitis, if you guys were here during the last talk, we defined gingivitis as inflammation of the gingiva. And typically this is a term used, or that applies to periodontal disease. There's different grades or severity or stages of gingivitis, but it's typically a purely dental or periodontal problem. It's not necessarily part of the – or it doesn't necessarily – in other words, when we have only gingivitis, but no inflammation or disease in other areas of the mouth, we can't really say that it's possibly chronic stomatitis even if it's very, very severe. Mucositis, on the other hand, is when the oral mucosa or an area of the oral mucosa different from the gingiva is affected or inflamed. And many people like to add a word to it to address the area that is inflamed. So you

can have mucositis in the caudal area of the mouth, in the buccal mucosa, sublingual mucosa, alveolar mucosa, et cetera.

Buccal mucosa, when I say buccal mucosa I mean the mucosa that is kind of on the inside part of the cheek. The alveolar mucosa is the one – gingiva is right here, and it's clearly separated by a mucal-gingival juncture in a line that is visible. So the mucosa immediately past that line is the alveolar mucosa. Alveolar, because it's got the alveolar bone underneath. And then once it turns around to the vestibulum, that's when it is referred to as the buccal mucosa.

So all these are typically happening when you have chronic stomatitis. So the entity, the clinical entity known as chronic stomatitis. Faucitis, I put in brackets, because it's a misused term. It's actually a lay term. It's not really an anatomical area. It's a lay term to refer to the area or the lateral walls inside the pharynx, in the oropharynx. Even though it can be affected in cases of chronic stomatitis, it is not typically part of the disease.

And the term stomatitis is used whenever there's widespread inflammation in the mouth. That would pretty much include mucositis and gingivitis kind of simultaneously. The entity known as chronic stomatitis has also received multiple other names. You've probably heard lipoplasma citic stomatitis or syndrome, or complex faucitis, et cetera, or feline chronic gingival stomatitis. It's received multiple names. But they all typically refer to widespread inflammation in the oral cavity that is of chronic duration. And the other important aspect of this clinical entity is that typically there's inflammation in the so-called caudal oral mucosa. So it's almost like a hallmark of the disease is inflammation back here.

The clinical impact of this disease is big. It's huge. This is a horrible disease. It affects significantly the quality of life of the cats. We're going to be talking mostly about cats, even though at the very end I'll talk about the entity in dogs, as well. It has a big nutritional impact, because these animals have a really hard time eating, or at least some of them. They sometimes feel very, very hungry, but are so painful they can't even pick up the food, or chew, or swallow. It is a disease that is a very difficult medical and surgical management. Medical management also is associated with a lot of side effects, especially if steroids are being used as part of a treatment plan. And unfortunately this disease very often results in euthanasia of affected animals.

Some people believe, too, that this chronic, severe inflammatory process in the mouth has the potential to go through malignant transformation and result in cancer of the oral cavity. And of course that in cats means

typically squamous cell carcinoma. It's not proven, but it makes sense that these lesions could potentially transform at some point.

The typical presenting complaints or clinical signs are panting, or bad breath, a lot of drooling. This is very common, as shown on this photo. This cat has a purulent discharge from the mouth. They are typically very painful, and don't tolerate oral and facial manipulation easily. They have a lot of difficulty eating. Sometimes they have a very poorly kept coat or hair, because they can't groom themselves. Many of these cats have gone through a lot of dental intervention, sometimes without proper documentation and misdiagnosis. And therefore, it's common to hear from the clients or previous owners that they have a history of simply bad teeth.

The physical exam, like I said, will reveal very painful cats. Oral examination in these cats is very difficult. You have to be very, very gentle and patient with these cats, because and also careful because they can react aggressively or violently, because of the pain. Mandibular lymph node enlargement is very common. Typically they have at least mildly, sometimes severely enlarged mandibular lymph nodes. They can present with some degree of dehydration, sometimes severe. And they can also be in a poor body condition from the fact that they can't feed themselves properly.

When you inspect the mouth, in the entity known as chronic stomatitis, typically the inflammation is a lot more than just gingivitis. And like I said, extends beyond the mucal-gingival juncture. If it doesn't affect other areas of the mouth, but just the gingiva, then it shouldn't really be called stomatitis. Buccal stomatitis, like I said, is when it affects the tissue that is on the inside of the cheek. And caudal stomatitis, like I mentioned, is the hallmark area that most severe inflammation and ulceration occurs.

Now the distribution of the lesions is typically very symmetrical, but not necessarily so. Some rare cases present with more unilateral lesions or distribution. The lesions themselves can be flat or proliferative. They can, like I said, affect different areas of the mouth, but typically always involve the caudal aspect of the mucosa or oral cavity. And periodontal disease can be happening as well, in different grades of severity and extent, and tooth resorption, as well. As a matter of fact, periodontal disease is very common in chronic stomatitis. Like in this example that I'm showing here, there's areas of severe ulceration in different areas of the mouth. And also it's very clear and obvious that severe periodontal disease is going on.

Just to show how most cases are symmetrical distribution, this is the typical bilaterally symmetrical. And this is an example of one of the rare cases where it was much more severe on one side.

Sublingual lesions are not always present, but they can happen too, and/or some of the tongue can happen as well. This one has a pretty bad ulcer close to the tip of the tongue. I mentioned that some are proliferative, some are flat. I showed you an example of a flat one. This is an example of a very proliferative one. This is another one. This is important clinically, because you can have a really hard time intubating these cats when the lesions are very proliferative. In fact, this one that I'm showing right here, I was in private practice when I saw this cat, and I was intubating myself. I didn't have an anesthesiologist doing the anesthesia. And I couldn't intubate this cat, and I had to abort the procedure. This one, an anesthesiologist was able to probably with an endoscope assisted intubate this cat. But it can be really, really challenging in some of these cases.

The blood tests, I would say there's no typical finding except for in about 50 percent of affected cats you will find an elevated globular levels. That is probably just the reflection of the chronic, severe inflammatory condition. In one study, they looked at 30 affected cats, and 32 controls. And this is where they came up with that number. And in practice, this is from my own personal experience, the number is probably higher than this. The only reason why some of these may not have elevated globulins is because some of them have received steroids recently or previously, and the steroids are known to at least temporarily decrease the levels of globulins in blood. So if you have a clear case of chronic stomatitis, but you don't have the elevated globulins, don't automatically think it's not stomatitis, because it can happen without the elevated globulins as well.

The radiographic findings are probably the reflection of whatever else is going on in the mouth in regards to periodontal disease, tooth resorption, endodontic disease, et cetera. And it's really important to document what's going on with the teeth of these cats, because there's – whatever treatment approach you decide to implement, you are going to have to no matter what address the teeth. And that, of course, will mean diagnosing early what's going on with the teeth, and addressing the dental part. Otherwise treatment will be most likely ineffective.

CT, of course, is unlikely to be a diagnostic tool that you have in the shelter setting. But I decided to include this slide, just to show how in some cases the inflammation is so severe and extensive – in this case, for example, this is one of the proliferative cases that I just showed you. The inflammation, this is of the caudal oral mucosa, right here. So this is typically what you can – the limit where you can see things in the mouth.

And this is the oropharynx, right here. So this is all the inflammation that was going on. This is contrast-enhanced CT. And here just on a sagittal view it shows the extent of the – this is the endotracheal tube right here. So this inflammation was extending back all the way to the larynx, pretty much.

Histopathology is also another useful diagnostic tool. And it's important, because even though it won't really reveal anything different from chronic inflammation, or very severe infiltrates of lymphocytes and plasma cells, which is a very non-specific finding, it simply reflects the severity of inflammation going on. And it's important because it does allow you to rule out other possible disease processes. In particular, the first two or most important rule-outs would include neoplasia, squamous cell carcinoma, and/or eosinophil granuloma.

In some cases you will actually find histopath signs of dysplasia, which is potentially an early sign of malignant transformation. These are the main rule-outs that I mentioned, and I included periodontal disease and tooth resorption because some of these cases, I've noticed, that get a diagnosis chronic stomatitis, when you investigate a little further and do proper diagnosis of dental disease, some of these cases you conclude that they're just very, very severe periodontal disease cases, and not necessarily chronic stomatitis. And I think that's important, because if you misdiagnose chronic stomatitis, and you decide to take a conservative approach, and typically that means treating with antibiotics, treating with analgesics, and many times treating with steroids, you're potentially treating with drugs that have the potential to cause a lot of side effects, when in reality the disease was very treatable from the beginning, without the need of these potentially harmful drugs.

The only good thing I would say from all these slides that I'm going to show you is that epidemiology, or the prevalence of the disease, is not as high as some people had believed it is. In one study, in this particular study, the prevalence was found – this was a British study – to be .7 percent. So it's not that high, fortunately. In another study, they found that the prevalence was close to 3 percent, but there's significant differences in what was considered to be chronic stomatitis, the definition of the disease. It at least historically has been somewhat vague and confusing. So that may account for the differences in prevalence. But no matter what, which of the two studies reflects better the reality, it's not a disease that you will potentially find every day, at least not on client-owned animals.

As I will mention in a few slides, the bad part about you guys is that this is a disease that is known to be more common in multi-cat environments, and of course that includes shelters. So it is likely, and you can tell me

better that, because I don't have anecdotal experience in shelters. But it may be the numbers may be higher in shelter settings.

Now male and female ratios are not different. There are no significant differences. In regards to age, the median for these studies has been approximately 8 years, however, the range is very, very wide and very young animals can be affected, and cases from a year or younger can clearly occur. Oh, this is what I was just mentioning. This is known to be a disease more common in multi-cat environments that includes catteries and shelters. And there is no established or known or documented breed predisposition, although some people have the belief that purebred cats have a higher propensity.

This is kind of to emphasize what I mentioned already, that periodontal disease and stomatitis can occur simultaneously. As a matter of fact, one study just came out where they looked at the periodontal status of 101 cats diagnosed with chronic stomatitis and compared with a similar number of control cats. And they established that there was a very high or significant correlation between periodontal disease and stomatitis. Pretty much every single cat of the 101 cats involved in the study had some degree of periodontal disease. 92 percent in which it was either moderate or severe, compared to the – and of 77 percent had generalized or semi-generalized distribution.

Tooth resorption was also quite high, higher than the control population. And other dental pathology as well, also common. So this is just to emphasize how even though you may be absolutely sure that the cat has chronic stomatitis, you still need to document what's going on with his teeth, because that will be critical when it comes to implementing the treatment.

In regards to the causes of the disease, this is the very little we know, I should say, because chronic stomatitis is a very poorly understood disease in the most part. So many factors have been suspected to be involved, and they include immune mediated factors, hypersensitivity to things like food, or the actual plaque that builds up on teeth, viral agents, bacterial agents, and also some people believe that it's just simply a complex or multifactorial disease.

In regards to viruses, calici, FIV, herpes, and leukemia virus have all been suspected to be involved. Of these four, probably calici and herpes virus have received the most attention, because multiple studies have demonstrated a likely association between stomatitis and especially calici virus. The association between the two, though, is not clear. And whether it plays a causative role or not is yet to be demonstrated. There's different things that can be going on, not necessarily a cause and effect relationship.

But regardless, many cats with chronic stomatitis are actively shedding calici virus, and many cats are actively shedding herpes virus.

This kind of makes sense with a multi-cat phenomenon, or predisposition phenomenon, which would kind of suggest or favor an infectious agent involved. Also, these cats with chronic stomatitis oftentimes have respiratory disease, either acute or chronic. But despite that, like I said, cause and effect is questionable, and I guess the things that disfavor this thought of involvement of the viruses are first that the results are not consistent among studies, at least in regards to the numbers. There's possible confounding factors, like many of the cats included in the study have gone through immunosuppressant therapies, steroids mostly, or live under stressful conditions, which can indirectly lead to activation or shedding of viruses which may or not be related to the disease. And it has never been possible to reproduce the disease using these viruses experimentally.

Bacteria. So one of the bacterial agent that has received most attention, and I think this slide is important because at some point, there was almost widespread belief that Bartonella could be the causative factor of stomatitis. This was based on very, very early research on Bartonella and histological changes associated with Bartonella that were typically seen as chronic inflammation, lymphoplasmacytic infiltrate of different tissues including the oral cavity.

However, that didn't really mean that chronic stomatitis, as we know it as a clinical entity that we know, was associated with Bartonella. So a bunch of studies came out after that, and none of which showed an association between the two. So I emphasize this because the serology that many people perform to check for Bartonella, and the treatment implemented to treat Bartonella, either empirically or based on serology results, is very unlikely to have any kind of positive impact on disease. So I think it's a little bit of waste of time and money and resources, trying to investigate and treat Bartonella in an attempt to address the stomatitis.

Immune-mediated disease, there's some evidence that would support this thought. Obviously the nature of the cells that are present in the tissues, the fact that the patients respond almost immediately, and very dramatically, to immunosuppressive agents, the fact that persistence of the lesions occurs despite the fact that some of the factors are removed sometimes, or possible factors, and also that some cats, even though many are actively shedding viruses, some are negative for known infectious agents.

Regardless of what causes the disease, I don't know how long it's going to be before we figure it out. But for now, we are limited to identifying,

based on clinical, historical, and radiographic information. And we are limited to implementing a treatment that may or not be effective. And there's two basic ways in which treatment can be implemented. The main one, or the first one, is a more conservative one where first of all we address every possible dental issue that is going on. Steroids are very effective, very fast in producing their positive effects. But they are very short-lived, and typically once they wear off, whether they're oral or injectable, the clinical signs and manifestations will come right back.

Oral antibiotics are effective while the animals are on the antibiotic. But once the drug is discontinued, the clinical signs recur. Oral hygiene is theoretically effective, but practically impossible to perform, because these cats are so painful that you're not going to be able to tooth brush these cats. The bottom line is that conservative management in the long term is highly unlikely to be successful, and it's in the most part, a symptomatic approach, trying to manage the clinical signs and manifestations, trying to provide somewhat improved quality of life. But in the long term, it's not really an effective approach.

Which leads us to the surgical management of these cats. And the information that we have is based on – historically it was based on one study, of a relatively small group of cats with somewhat vague definition of the disease. However, there's newer information that is coming out to try to confirm or disprove this data, and it seems to be very consistent. So despite the limitations of the initial data that was available, it seems to be actually a good reflection of what happens in reality. And what I mean by that is that extractions, whether they're done as near full-mouth or as full-mouth extractions in affected cats, seems to be effective in, or at least partially effective, in approximately 60 to 80 percent of cats.

So 60 to 80 percent of cats will show a significant clinical improvement, or be considered "cured." And cured means that clinical signs will disappear, and the lesions in the mouth will also resolve. However, some of these cats, the ones that are considered improved but not cured, are where the clinical signs are improved, but the oral inflammation persists to some degree.

13 percent will be still symptomatic enough to require intervention, but will be improved compared to what they were before extractions. And 70 percent, approximately, are simply unresponsive or refractory to the extractions approach.

Now, the surgical treatment has significant implications. The first one, and most important I think, would be that it's a very technique-sensitive approach in the sense that the extractions have to be performed with impeccable technique. So things like leaving little tiny root fragments

behind are enough to make the whole thing fail, the whole approach fail. So again, I come back to the topic of radiography – proper setup, proper tools, and also proper skills, training in regards to extraction technique. That's one thing. The other thing is that they're very long procedures, because it's so technique sensitive. Some of these teeth are really hard to extract, or undergoing tooth resorption. They're fragile. They break easily. So it can be pretty easily a five-hour procedure.

It is very invasive, because the tissues are so already messed up before the surgery. And with the surgical manipulation, they become even more so. These cats will have a miserable first night at least, or first couple of nights. That means aggressive intervention with analgesia, patient support. So it requires a hospital setting, probably. This is what it looks like right after surgery. You know, this is going to be really, really painful for the cat. And this is what happens if little pieces of root are left behind. Sometimes the inflammation clears up in certain areas. But in especially the areas where the roots are left behind, this is what's going to happen.

Laser ablation of the lesions has been much talked about by many clinicians. However, this was the idea of one group. And I don't know how many cats they worked on, but in the literature there's only one case report available. So this is very weak evidence. I don't think any shelter should invest in a laser just to be able to treat stomatitis cats with potentially very minimal benefits to the cat. So even though in the clinic here at Cornell we do have a laser, I don't even bother using it in stomatitis, because I don't think the evidence is sufficient to support this kind of approach.

A medical option that we have, or has a lot of potential nowadays, and it is being talked about quite a bit, is the use of recombinant feline Interferon, omega Interferon. So there's some data out there. It's showing promising results. The protocols are still to be defined. Is it used topically? Is it used intralesionally? Is it used orally? Is it used via any other route? It hasn't been established. But the very little data that has become available is promising and encouraging. The biggest limitation in regards to this option is that it's not available here in the US. So this is available to Europeans, and in Canada it's available, but not here in the US.

The other implication of the use of these newer medical options is that they have been tested in animals that have been refractory to the surgical approach. So are these going to be options instead of the surgical management? I doubt it. So these options that I'm going to mention, the Interferon and the other one I'm going to mention, which is Cyclosporine, are most likely to be effective if surgical intervention has failed, not – unlikely to be effective if extractions haven't been performed.

Cyclosporine is the other medical option that is showing some promising results. So far there's only one study that has looked at the effects or benefits of Cyclosporine in the management of refractory chronic stomatitis. And like I just mentioned, these are all cats that have gone through medical-surgical management, and been refractory. And in this paper, that included 16 cats. It showed quite encouraging results. There's a lot of – or not a lot, but some clinical, I wouldn't call it limitations, but important aspects to be considered, or considerations is the appropriate word. One of them is that this is orally administered Cyclosporine. One big consideration is that the absorption is very variable in cats, the oral or systemic absorption of orally administered Cyclosporine is incredibly varied in cats, and the doses will need to be adjusted individually based on serum levels detected after the treatment has been implemented for a while. In this study they used one month after the treatment was started. They looked at serum levels. They found an incredibly high variation in blood levels, and they had to adjust the levels individually.

And they also showed that underneath a certain level of Cyclosporine circulating in the body, it was unlikely to be effective. And they established a proposed range. So they proposed that anything underneath 300, I think it's micrograms per deciliter in blood, or I can't remember the exact units. But beyond a certain range or under a certain range, it is unlikely to be therapeutic. And therefore, it is recommended that the serum levels be checked every so often to make sure that the animal is receiving the proper dose. It has a lot of potential, because if it is eventually proven to be a good way to treat these cats, even though it's not side-effect free, the side effects of Cyclosporine are incredibly less than things like steroids.

Now, in regards to prevention, it's really hard to implement prevention measures if we don't even understand the disease mechanisms and causative factors involved. But in general, this is based on the speculated disease mechanisms and agents. I would say that in a shelter environment it would make sense to implement measures that can reduce the stress level of the individuals and prevent the possible spread of infectious agents, things that I think everybody already does or tries to do. Isolate individuals that are affected. I don't know if what will be affected, but it could be considered. I think that it is really important to be sure of the diagnosis before any decision is made.

Whatever decision you make, whether it's to isolate, to euthanize, to try to treat the animal, I think the first thing you need to do is be sure that this is actually what the cat has. Treat only if necessary tools are available, especially if you're taking a surgical approach. Or yeah, otherwise it can be quite traumatic for the cat. Avoid using steroids and treat symptomatically. Some people believe that steroid use will increase the

chances of failure of any future approach. So some people believe that cats that have undergone a lot of steroid treatment by the time they come to get the extractions done, those are the cats that are less likely to respond favorably.

If at all possible, the management of these cats should be done by a specialist. I will – of course that's not always the case, or that's not always feasible. I think it's really important to inform the new owners of cats that have this condition about the implications. I've certainly seen a couple of cases that people have adopted a cat, and they had no idea that there was something wrong in the mouth. And eventually they find out that there was chronic stomatitis from the beginning, when they got the animal. And it can be quite an awkward situation. I think there's a pretty good chance that they're going to come back to the shelter. And yeah, like I said, be sure of the diagnosis before more extreme measures are implemented. You know, if euthanasia is going to be an option, I think it's only fair with the cat that it's properly diagnosed.

Stomatitis can also happen in dogs. Whether it's a similar disease or a completely different one is unclear. This is just as poorly understood in dogs as it is in cats. The distribution of the lesions is a little bit different, because stomatitis typically is directly associated with teeth that are present, and teeth oftentimes that have ongoing periodontal disease, like for example, this is a typical appearance of a lesion in a dog. In this case it's associated with this canine tooth that has a lot of disease going on, gingival recession, a lot of plaque accumulation, calculus, et cetera. So some people refer to this condition in dogs as CUPS, which stands for chronic ulcerative paradental stomatitis, paradental meaning that it is along the areas that come in contact with the tooth.

It's also received the name chronic alternative stomatitis, or canine chronic stomatitis. So it may or not be similar to what happens to cats. The distribution of the lesions is slightly different. There are also differences in regards to response to treatment. The signs and complaints are very similar, though. Again, another example of why distributions of the lesions can be different. This is – sometimes the margin of the tongue can be quite ulcerated, and especially in the areas that come in contact with the teeth. That's kind of why it's sometimes referred to as paradental stomatitis. The caudal oral mucosa is not typically affected as it is in dogs – in cats, I'm sorry. And oftentimes there's quite significant, severe, extensive periodontal disease going on.

Differential diagnoses would include lymphoma and immune-mediated disease. Erythema multiforme can manifest very similarly in the mouth of a dog. If you have ulcerations in areas that are not directly in contact with the teeth, like for example right here, this is the hard palate. Shouldn't be

ulcerated if it was the entity known as chronic stomatitis. In this case, the mucocutaneous juncture was affected as well. So in these cases I would certainly make sure I get a biopsy before I diagnose.

Treatment, unlike cats, tends to be unresponsive to steroids. So don't even bother giving steroids to these dogs, because typically what they need is dental intervention. So not only keeping the teeth free of plaque and calculus, but making sure that any teeth that have severe disease come out. And where there's severe ulcerations, no matter how severe or not the disease is, say if you have a very severe ulceration right here, however, the tooth is not necessarily – so disease may be a good idea to remove the tooth, because most likely that will resolve in resolution of the ulcers.

Antibiotics and analgesics would probably have more of a symptomatic effect than anything else. So the treatment will include complete periodontal documentation and intervention, extraction of teeth associated with the ulcerations, strict plaque control will be fundamental. These dogs are more likely to tolerate home care than cats. Medical intervention can be in the form of Pentoxifylline, and/or Metronidazole, even though there are no studies to back this up. I can tell you anecdotally Metronidazole is very effective while they're on it. But like I said, in cats things will recur if the antibiotic is discontinued. Some people believe that this may have a positive effect, especially if there's any kind of immune-mediated mechanism involved. This is commonly used to treat vasculitis and other immune-mediated processes.

And if cases are severe and totally unresponsive to this initially more conservative approach, then full-mouth extractions can be tried. However, that's massive surgery, especially a dog has 42 teeth. If they're not – it can be a very long and involved surgery. So the few cases that I've had to do full-mouth extractions, I typically actually stage the surgery, because doing half the mouth, just half the mouth, will take probably four to five hours.

This is an example of a case in which precisely half the mouth was done due to severe unresponsive disease. And look at how just a couple weeks later the disease had cleared pretty much everywhere. Like went from here, severe ulceration and bleeding everywhere to minimal residual lesions, probably going to completely clear as the sutures disappear and the traction sites heal. And this is when the dog came in for the second half of the mouth.

So in conclusion, stomatitis is frustrating. We know very little. There's no real way to resolve in a predictable manner. And the diagnostic and treatment options will require the appropriate tools and setup and skills.

But even so, if everything is done properly, the outcome is not always necessarily great.

Now, very quickly, about tooth resorption. I think we have a couple more minutes. It's very common dental pathology in cats especially even though it can happen in any species. In dogs it's actually not rare. Prevalence has been reported to be – it varies between sizes, but there's numbers between 40 to 70 percent. It is considered a very painful problem. So it's certainly one of clinical significance. We don't know what causes it. Certain areas along the tooth is more likely to have the process going on. The buccal area, the cervical area is the typical one. And older animals are more likely to have disease. And it can affect multiple teeth, whether simultaneously or at different stages of life.

The recognition of the lesions can be not necessarily obvious. So sometimes the area of resorption is filled by either enlarged or hypoplastic gingival tissue, or granulation tissue. So they can appear as slight irregularities and enlarged areas of soft tissue over the crown of the tooth. Sometimes all they have is this pinkish hue to them, probably because of the resorption is going on within the tooth, not necessarily visible. And some cases, especially the end-stage ones, where the crown has resorbed to a point where it snaps off, but there's residual root remnants, or root tissue, or crown tissue, you can have some inflammation around those pieces of tooth left behind. These are just common examples of what they look like clinically.

Sometimes you need an explorer to find the lesion, because it's hiding under the gingiva in the sulcular space. And radiographically, again, radiographs are crucial to document the extent of the lesion within the tooth itself, and to reveal if there's resorption that is affecting the root and not necessarily the crown of the tooth. So sometimes there's a lot of resorption at the root, but not so obvious at the crown. And these are just examples of our radiograph. Like in this case, maybe clinically there was a tiny pinpoint spot here visible. But radiograph reveals that it's actually massive resorption going on.

Couple examples of a dog, just to demonstrate that it can happen in dogs as well, and it can present in a very similar manner. And the treatment is extraction of the tooth. An extraction can be very tricky, because they're very brittle, fragile teeth. The ones that have a lot of resorption will break very easily. And they need to be extracted with care, with delicate technique. And I bring this sequence of photos up, because a lot of people think that coronectomy, which is cutting off the crown of the tooth and leaving behind the roots, is applicable to any situation where tooth resorption occurs.

And I want to point out that it is a valid approach, but not in every case. It is only valid – oh, I thought I had the radiograph slide. Hm. I forgot to include the radiograph. Okay, I'll use this one to kind of show when it can be used and when not. So in cases where radiograph shows that the resorption along the root is advanced, severe, that extraction is going to be really hard, because the tooth structure or the tissue is no longer there, or it's fused to the bone and extraction would be incredibly traumatic and unsuccessful. Then it's valid to raise the flap, expose the cervical area of the tooth with a burr, cut the crown off, smooth out the underlying hard tissues. Here's an amputated crown. And suture the flap over. And this is what it would look like radiographically.

It's valid, like I said, when the resorption along the roots is such that extraction of the root would be simply impossible or too traumatic. Whenever the periodontal ligament is visible on the radiograph, full extraction should be performed. That's it. *[Applause]* Thank you.

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