Diagnosis of Endodontic Disease

With more and more clinics equipping themselves to take intra-oral dental radiographs, I can start shifting my attention away from convincing you to take radiographs and start focusing on helping you interpret the images you obtain. Therefore, I will be offering a (semi) regular feature on radiographic interpretation, usually based on a particularly illustrative case. This issue we will look at diagnosing endodontic disease.

Before delving into this, I need to refer you to some previous articles for background and review.

The Tooth gives a brief overview of the anatomy of (you guessed it), the tooth. Endodontic Anatomy &Physiology also has a pretty self-explanatory title. There is also an article in the Journal of Veterinary Dentistry you should get a hold of *Hale FA. Localized Intrinsic Staining of Teeth Due to Pulpitis and Pulp Necrosis in Dogs. J Vet Dent, 18(1), pp14-20, 2001.*

There are some teeth that provide ample evidence of pulp necrosis or endodontic compromise that necessitates treatment, so let's look at some simple examples first.

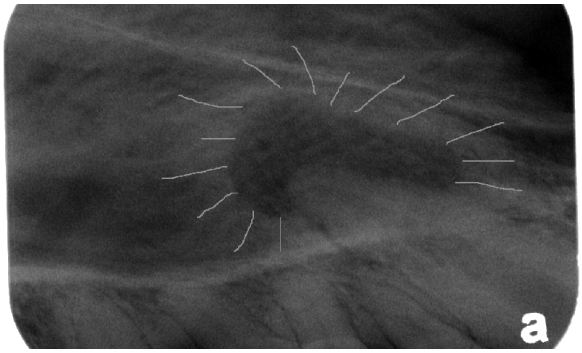
When a tooth is fractured and there is pulp exposure, that is all you need to know to be certain that the tooth needs either root canal treatment or extraction. Those are the only options. "Wait and see" is not an option. Antibiotics will be of no value. Definitive treatment to close this open wound is required as the body has no capacity to heal this damage.

Periapical Lucency

The right upper canine tooth in the radiograph had a crown fracture with an obvious pulp exposure. This allows bacteria into the tooth, where they will inevitably kill the pulp. In time, it is also inevitable that the bacteria will ooze out through the apical delta into the periodontal ligament space around the root tip. In time, this will always lead to chronic infection and inflammation at the root tip. This inflammation and infection will result in demineralization of the periapical bone and may also result in external inflammatory root resorption.

This radiograph shows a very large and obvious periapical lucency; most are not nearly this large. In order for a lucency to be radiographically evident, it is said that there must be about 40% bone loss and that does not happen over night. How long it actually does take can be quite variable but you are safe in saying that when there is an obvious lucency as seen here, that fracture is 'old' and the infection is chronic.

Now suppose there had only been 25% bone loss. In that instance, the radiograph would have looked perfectly normal (a false negative).



Just to add a measure of confusion, there may be an apparent periapical lucency that is actually normal anatomy and this is referred to as the Chevron Sign. See this paper - Chevron.pdf.

Pulp Chamber Size

Recall from your previous reading that the pulp chamber in a newly erupted tooth is very large and the dentin wall of the tooth is thin. As long as the pulp is alive, cells lining the pulp chamber (odontoblasts) produce dentin inside the tooth so that over time, the wall of the tooth is growing thicker and the pulp chamber getting smaller. This is a rapid process early in life so that the difference in pulp chamber size between one-year of age and two-years of age is very noticeable. Later in life, the difference in pulp chamber size from year to year is very minor. A radiograph of a healthy canine tooth in an eleven-year old lab will likely look indistinguishable from a radiograph of that same tooth taken a year earlier.

In the above radiograph, the canine at the top of the image has a very large pulp chamber compared to all the other teeth, especially the canine at the bottom of the picture. Like the old Sesame Street song, "one of these teeth is not like the others". The massive pulp chamber indicates that the pulp in that tooth died when the dog was less than a year of age. The size of

the chambers in the rest of the teeth indicate that the patient is likely over six years of age, so that canine tooth has been dead for five years or so. The chronic periapical infection has resulted in external resorption of the root tip and there was a draining fistula into the oral cavity.

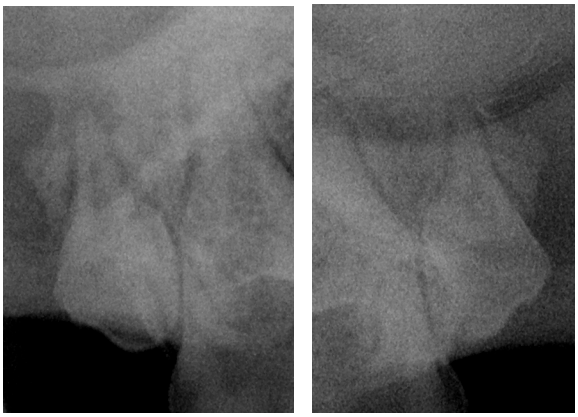
The other possibility is that the pulp chamber in the diseased tooth may be smaller than in the normal teeth. A traumatized but unbroken tooth may develop a chronic pulpitis. That can stimulate the odontoblasts to produce reparative dentin more rapidly than the normal dentin production in the other teeth. Therefore the diseased tooth will have a smaller-than-normal pulp chamber. This tooth might then go on to die, at which time the dentin production will stop and eventually, the other teeth will catch up and then surpass the dead tooth. Depending on the timing of your radiograph, you may again get a false negative.

So, depending on how old the animal was when the pulp died, how long ago it died and whether or not there was reparative dentin production before it died, the pulp chamber in the dead tooth may be larger than in the healthy teeth, the same size or even smaller.

Transillumination

My articles referenced at the beginning of this piece discuss the changed optical characteristics of some teeth with endodontic disease/pulp necrosis. Specifically, they talk about crowns that are obviously discoloured pink, purple, grey, tan… compared to the other teeth.

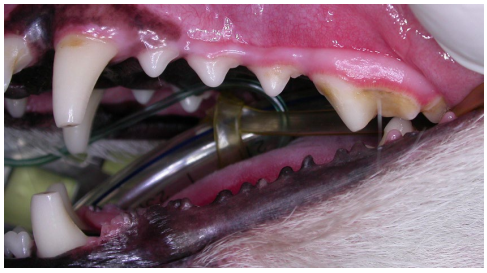
In the photo above, the right maxillary second molar has a purple hue to it, especially when compared to all the other teeth in the field of view. This is a very strong indicator of pulp necrosis. As the radiographs show, the tooth has been dead a long time. In the film on the right, the pulp chambers in the second molar are much larger than those on the left and there is also an evident periapical lucency at the distal root of the dead tooth. In this case we have three pieces of evidence that the right maxillary second molar has pulp necrosis (discoloured crown, larger-than-normal pulp chambers and periapical lucency) and so it is easy to state that this tooth needs root canal treatment or extraction. I extracted it.



Not all dead teeth are considerate enough to discolour so obviously yet their optical characteristics may still be detectably altered. To assess this, we use the trick of transillumination. Basically, a small, bright light is directed through the crown of the tooth and viewed from the other side.

Transillumination works best for assessing large teeth (canine, fourth premolar, lower first molar) in relatively young animals. These teeth have a fair amount of pulp within their crowns and if that pulp is alive, there will be fresh blood flowing through that pulp. As the light passes through the crown of the tooth, the blood absorbs all but the red light and so the tooth gives off a pink glow. If the tooth is dead there is no blood flow and so the tooth does not give off that healthy pink glow. If the crown is small (first premolar) or the pulp chamber very small due to age or reparative dentin production, then there will not be enough blood in the crown to show through all the surrounding dentin and the test will be inconclusive.

Here is a case of a mature JRT who has done considerable damage to many of her teeth. The tips of all four canine teeth are abraded flat with exposed dentin.



The mesial cusps of the upper fourth premolars each have chip fractures with exposed dentin as does the mesial cups of the right lower first molar.

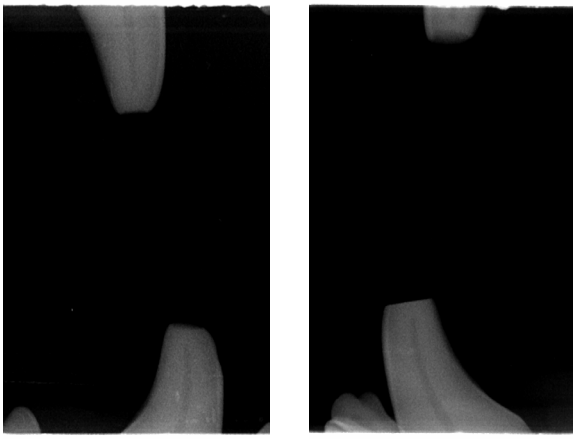
In doing the whole-mouth intra-oral radiographic study (standard procedure especially for a mouth with this much damage), I obtained the following images (among others).

The right upper canine tooth.

The left upper canine tooth.

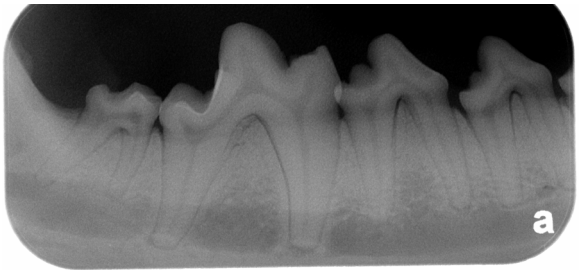
The lower canine teeth.

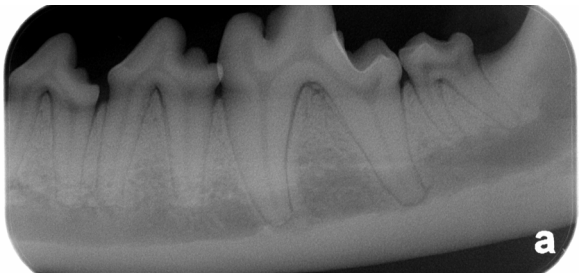
The crowns of the canine teeth (almost missed the left upper).



The pulp chamber in each canine is similar in size to the other three, there are no periapical lucencies and there appears to be a satisfactory amount of reparative dentin between the tips of the crowns and the pulp within. On balance, nothing has been found to suggest endodontic disease in these teeth.

Images of the right and left caudal mandibles are also within normal limits.



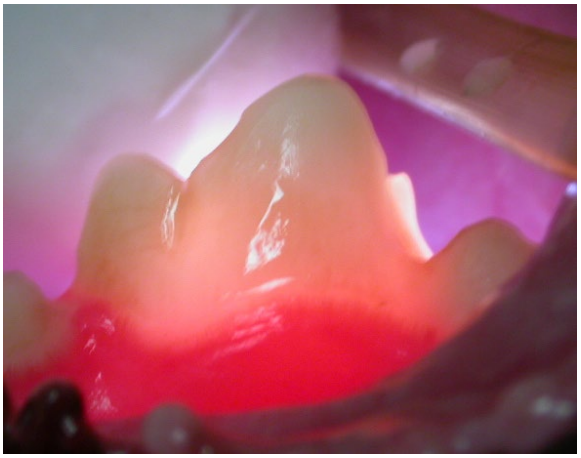


Everything looked fine on the image of the right caudal maxilla.

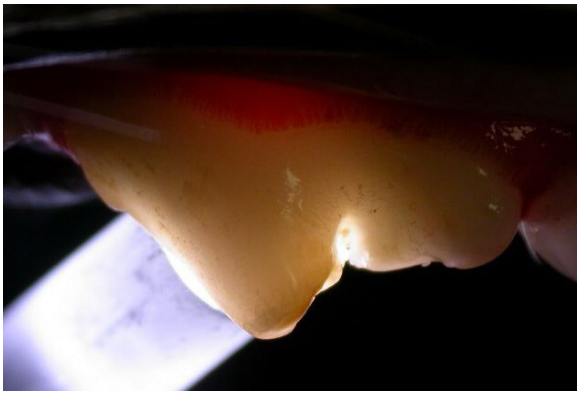
The image of the left caudal maxilla tells a different tale.

I suppose I could have shared that the dog was presented for a left-sided facial swelling, raising the suspicion that the left upper fourth premolar was the culprit, but that would have ruined the fun. Clinically, the tooth had nothing more than a small chip fracture the likes of which you probably see every day and think nothing of it. Radiographically, there is a massive periapical lucency around the distal root and similar lesions visible at the two mesial roots. Note that the pulp chamber size in this left upper fourth premolar is similar to the right upper fourth, so if we were seeing this tooth after the pulp died but before there was the massive periapical bone loss, there would have been no radiographic signs of trouble. Enter transillumination. This is a tricky thing to get good photographs of because the light points at the camera and the tooth is back-lit, confusing the light meter in the camera. This case actually worked really well though.

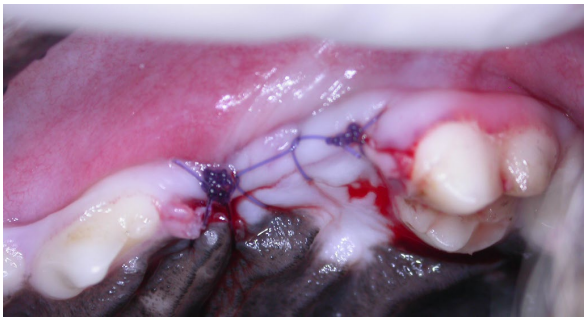
The next photo is of the radiographically normal left lower molar tooth. Note the 'happy' pink glow given off by the crown of this tooth.



The picture at the top of page eight is of the dead left upper fourth premolar tooth. Note the absence of that vital glow.



And here is a post-op photo after sectioning and extracting the tooth, curetting all the inflamed soft tissue from the alveoli and suturing the wound with 4-0 Monocryl™.

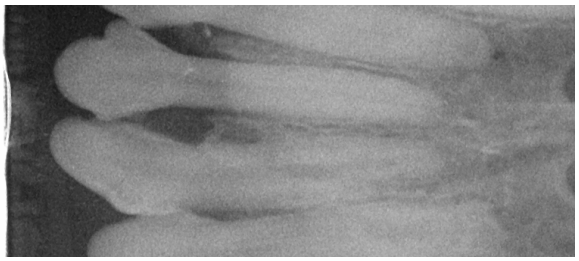


I do not have photos, but I can tell you all the other damaged teeth in this dog's head transilluminated normally. For those other teeth, my discharge statement reads "no clinical or radiographic evidence of endodontic disease at this time." That is not saying that all the pulps in the other teeth are alive and happy. They might be or they might all be about to die next week. All I can say is that I could find no justification for doing either root canal treatment or

extraction to any teeth other than the left upper fourth premolar. We will re-evaluate all teeth clinically and radiographically in a year to monitor for any changes or new damage.

Here is another case; this time, a mature miniature schnauzer. The left upper first incisor is ever-so-slightly discoloured.

The rostral maxillary radiograph shows that the pulp chamber in this tooth is noticeably larger than in the right upper first incisor.



While I usually would not figure transillumination to work well for such a small tooth, the photo below shows that the optical characteristics of the right and left upper first incisors are decidedly different. I did not need transillumination to know that this tooth needed treatment as the radiograph told me that beyond doubt. I was just playing around to see if transillumination would work for such a small tooth and it did.

Conclusion

Sometimes diagnosing endodontic disease is as simple as looking at the crown and seeing the pulp exposure. Sometimes the situation is far less obvious and so we need to collect more pieces of the puzzle to come to a rational treatment decision. Visual examination, probing and exploration, radiographs and transillumination are all valuable tools, especially when used together and when comparing the suspect tooth to the same tooth on the other side of the head or another similar tooth elsewhere in the mouth. If a definite answer still eludes you, plan to re-evaluate the tooth in six to twelve months to monitor for changes that either confirm normal pulp activity or indicate pulp necrosis.