

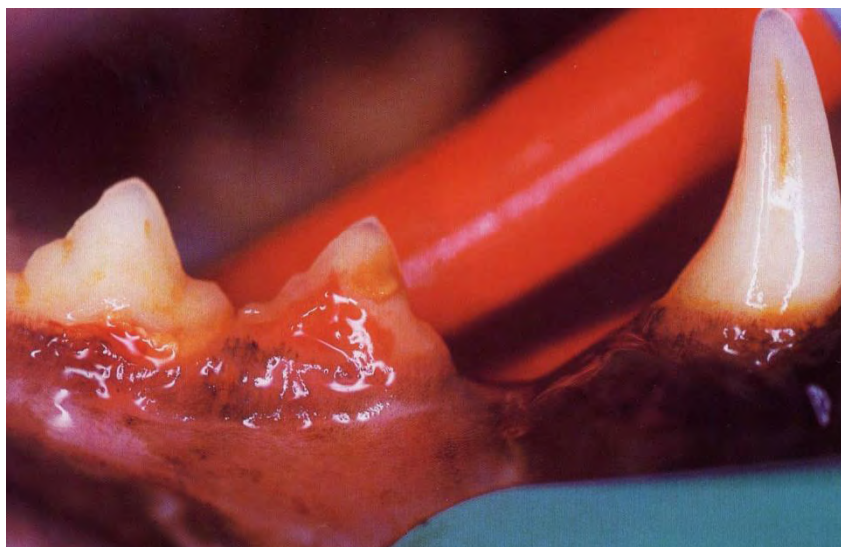
# Feline Tooth Resorption Lesions

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## Introduction

Over the last thirty years, the veterinary world has become increasingly aware of the phenomenon of the dental resorptive lesion in cats. Nomenclature varies but the term in common use since 2009 is **Tooth Resorption lesions (TR)**. The species can be added as a prefix.

The phenomenon may well be cyclical from the initial reports in the 1900's to the present day. Most recent surveys could well indicate a reduction in the incidence level compared with the last three decades. (Wiggs 2003)



These lesions are seen in other species, specifically dogs, pigs, humans, rats, mice and marmosets to date (**Du Pont 2002**). However, the incidence in the feline has become, and remains, relatively high. The earliest contemporary reference to them in veterinary literature is often quoted as 1976 (Schenk 1976). However a paper from 1955 (Tholen 1987) quoted “*erosions below the crown of the tooth*”. The oldest known reference is by Hopewell-Smith in the Dental Cosmos journal of the University of Pennsylvania that describes them as long ago as 1930 (Hopewell-Smith 1930).

Surveys of cat teeth from the 1980's onwards indicated initially an alarming rise in the incidence of this problem before the reduction in incidence reported since 2000 or so. Given the need for radiology for proper diagnosis, older surveys not using radiographs will mean under-diagnosing lesions.

In the surveys listed below approximately, 29% of cats within the general feline population and 54% of cats with demonstrable dental disease were shown to have at least one TR lesion. One study of 109 healthy cats indicated an incidence of 38% in mixed breed cats and 70% in purebred cats (**Girard N 2008**)

Under reporting of TR lesions is almost certainly a problem in these surveys given that many fragmented or missing teeth were lost due to resorptive lesions and that 81% of cats with one or more retained roots were also found to have a clinically evident resorptive lesion (**Du Pont 2002**). One study attempted a comparison between domestic, feral and captive exotic cats (**Levin 1996**). Statistical analysis is currently only available for one group (feral cats) but the indication is that the same disease process takes place with a much lower incidence than in the domestic feline population (9.5% of those younger than six years showing at least one affected tooth and 17% of those older than six years).

The location of TR lesions is approximately 90% on the labial/buccal aspect of the teeth. The most commonly affected teeth being the upper fourth premolar, lower first molar and lower third premolar.

## Pathophysiology

Histologically, TR's in cats are initially half-moon concavities in the structure of the tooth starting on the cementum surface. (**Burke 2000: Dubelzig 1990**) The destruction of the dental tissues is associated with cellular digestion of the dental tissues by multi-nucleated giant cells analogous to osteoclasts (odontoclasts).

Stem cells are attracted to the periodontal ligament area by inflammatory cytokines and are transformed into clast type cells. These clast cells then erode the mineralised tissues such as cementum, dentine and enamel. The lesions are lined by these cells and are non-carious. The dental margins are fully mineralised, hard and scalloped to support this fact. Histopathologic examination (**Gorrel 2002**) shows that TR's in cats are essentially an inflammatory disease of the periodontium that extends to the surrounding tissues. The inflammation affects large parts of the surface of the tooth and is characterised by both resorptive and reparative phases.

## **Incidence**

The incidence of these lesions in cats has been documented in a number of surveys over the past few years (see further reading list). The populations defined in these surveys are both the general feline population and the feline populations with dentistry bias (i.e. those individuals who were presented for dental or oral cavity problems). Surveys on this subject have become more numerous and sophisticated over the years – mainly by the inclusion of radiographic diagnosis as a routine. The main surveys from 1982 to 2001 are as follows;

### **General Population** (average 29%)

*Schlup (1982); Switzerland 28.5% of cats had one or more lesions. (n = 200)*

*Zetner (1987); Austria 28% of cats had one or more lesions. (n =?)*

*Coles (1989); Australia 52% of cats had one or more lesions. (n = 64) (2)*

*Mulligan (1989); California, USA 20% of cats had one or more lesions. (3) (n =?)*

*Harvey (1992); USA 26% of cats had one or more lesions. (n = 794) (4)*

*Zetner (1992); Austria 23% of cats had one or more lesions (n = 500) (5)*

*Wiggs (1993); Texas, USA 28% of cats had one or more lesions (n=214)*

*Okuda et al (1994); Japan 22.5% of cats had one or more lesions (n = 138)*

*Clarke (1994); Australia 29% of cats had one or more lesions (n= 168)*

*Verhaert (2000). Belgium. 25% of cats ha at least 1 lesion (n=753)*

*Ingham et al (2001); UK 29% of cats had one or more lesions (n=228)*

*Girard et al (2008); France. 38% (mixed breed cats) and 70% (pedigree cats) n=109*

### **Population with dentistry bias** (average 54%)

*Tholen (1987); New York, USA 65% of cats displayed at least one lesion. (n = 465) (6)*

*Zetner (1990); Austria 46% of cats with chronic oral disease & one lesion or more. (n=24)*

*Crossley (1991); UK 57% of cats displayed at least one lesion (n = 152). (7)*

*Remeus (1991); Holland 43% of cats displayed more than one lesion. (n = 308)*

*Harvey (1992); USA 67% of cats displayed more than one lesion. (n = 78)*

*Van Wessum (1992): Holland 62% of cats displayed more than 1 lesion (n = 432)*

*Wiggs (1993): Texas, USA 42% of cats displayed more than one lesion (n=252)*

*Okuda et al (1994): Japan 48.1% of cats displayed more than 1 lesion (n = 81)*

*Harvey et al (2000): USA. 43% of cats with TR's – mean number affected teeth 4.4 (n=162)*

*Lommer et al (2001): USA. 67% of cats displayed an ORL. Radiographs used. (n=147)*

## **AETIOLOGY.**

Research indicates that this is a complex disease with several causative factors interacting. Although diet is included in this list, many other factors may be responsible.

Work by Gorrel and others indicates that development of TR on the cement root surfaces does NOT require inflammation (*Gorrel 2002*). All cats appear to develop cemental surface resorption in life and some cats heal with restoration of normal periodontal attachment whereas in others, the lesions deepen to affect dentine and go on to develop destructive ankylosis. Any factor that creates abnormal formation or results in a deficiency of dentine or cementum mineralisation could precipitate the development of resorptive lesions.

The quality of cementum may vary because of differing hormonal and dietary factors predisposing some cats to development of clinical lesions. Excessive vitamin D intake over many years has been considered as a significant factor (*Reiter 2004*) but this was contradicted by another study (*Girard 2008*)

Over the years, papers have occasionally considered the effects of occlusal stresses and/or periodontal disease as aetiological factors via external inflammatory or non-inflammatory processes (*Burke T, Johnston NW 2000. Harvey 1992, Girard 2008*).

One current direction of research is focusing on treatment using the bisphosphonate group of drugs (*Alendronate™: Merck*) that bind to hydroxyapatite in bone and root surfaces and inhibit the clastic activity that causes apoptosis (programmed cell death). In a proof-of-concept study (*Mohn 2009*), it was used at 9mg/kg twice weekly and appeared to slow or arrest the progression of lesions. This is based on the assumption that the periodontal ligament is an area of high uptake of factors that mediate clastic activity – otherwise why does “rubber jaw” not become “rubber leg”? (*Harvey 2004*).

To date this drug has not been used in cats out of a research setting due to the logistical difficulties of safe administration and the fear of side effects.

## **DIAGNOSIS**

Clinically these lesions are intensely painful when on the crown and open to the oral cavity and are often associated with irritative, gnawing movements of the jaws during mastication. In an anaesthetised animal, it is common to produce a reaction when a lesion is found accidentally during routine probing of the sulcus. Clearly, the pain from these lesions must debilitate the cat but, as with many painful dental conditions in animals, the host seems to “live” with the problem without overt external stimuli. Often the only way to determine how much of a burden the pain was for the animal is to note the difference in demeanour before and after treatment.

There are three main methods for diagnosing the presence of TR's in cats.

**1) VISUAL**

- Red zone of inflamed gingiva over lesion.
- Check commonly affected teeth: upper PM4 (108/208), Lower M1 (409/309) & lower PM3 (307/407).

**2) TACTILE.**

- Using a sharp explorer look for TR's in the sulcus area.
- Due to the vascularity of the lesion, this may cause pronounced bleeding.

**3) RADIOLOGY.**

- The definitive method and recommended mode of diagnosis
- Should be used if either of the above two methods gives rise to suspicion.
- Best performed with a dental x-ray machine due to the small size of mouth & film
- Areas of lysis of tooth tissues are known to be rapidly progressive.
- Beware the phenomenon known as “cervical burn-out” where excessive exposure can give rise to confusion at the tooth neck.
- Sentinel teeth (307/407). One study (Heaton 2004) indicted that if these teeth are missing or affected it is a 93% predictor of TR lesions elsewhere in the mouth.

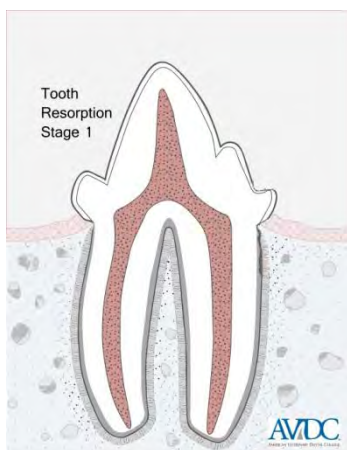
## TYPING AND STAGING

The definitive guide to this can be found on the American Veterinary Dental College website <http://www.avdc.org/nomenclature.html#resorption> DentalVets 2013

### Classification of lesion is based on severity (stage) and location (type).

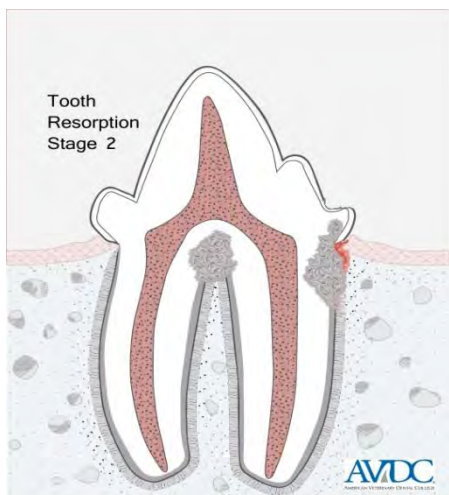
Some lesions result in total root resorption whilst others degenerate less drastically retaining key organic element of the tooth - such as the periodontal ligament and pulp. If organic tissue is retained they need treated differently from those which do not retain these tissues. Therefore, to enable logical treatment planning they must first be staged and typed.

### *Lesions are staged 1-5 depending on severity of the actual lesion.*



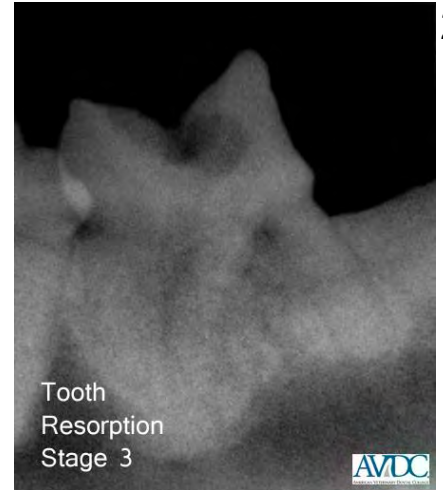
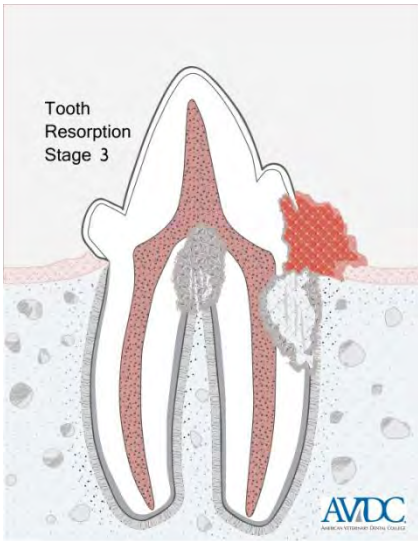
**Stage 1 (TR 1):** Mild dental hard tissue loss (cementum or cementum and enamel).

**Stage 2 (TR 2):** Moderate dental hard tissue loss (cementum or cementum and enamel with loss of dentin that does not extend to the pulp cavity). The tooth becomes painful if the sensitive dentine tubules are exposed to air.



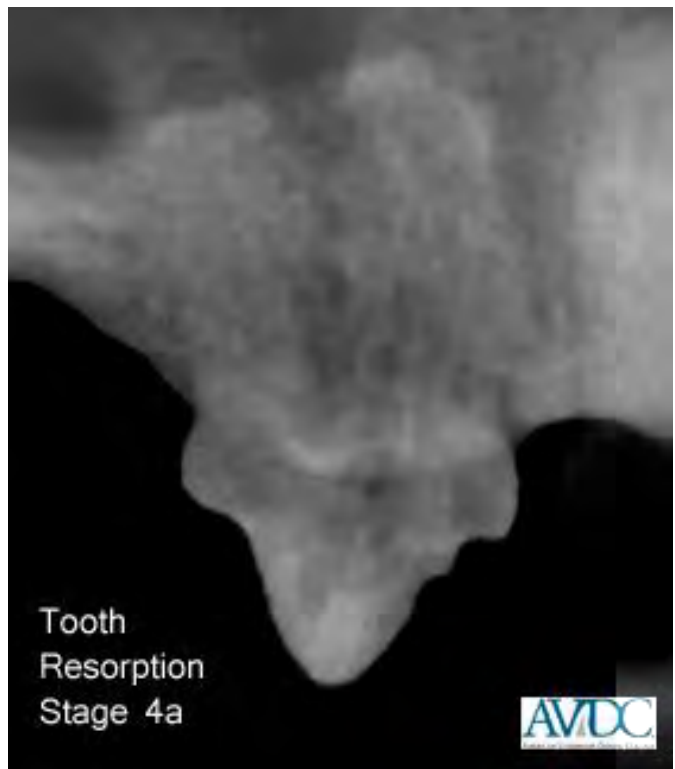
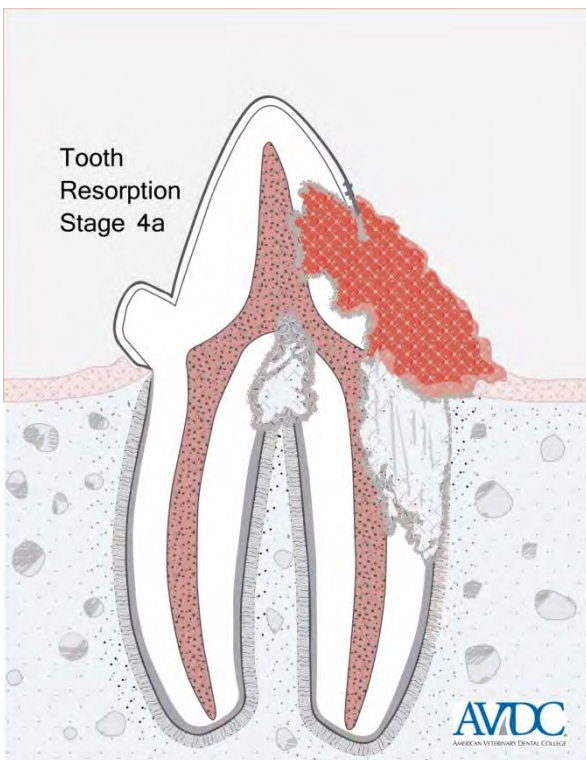
**Stage 3 (TR 3):** Deep dental hard tissue loss (cementum or cementum and enamel with loss of dentin that extends to the pulp cavity); most of the tooth retains its integrity. Stage 3 lesions are very painful if exposed to air and bleeding from pulp tissue will be evident on probing. Early “ghost images” of roots may be evident now on radiographs.





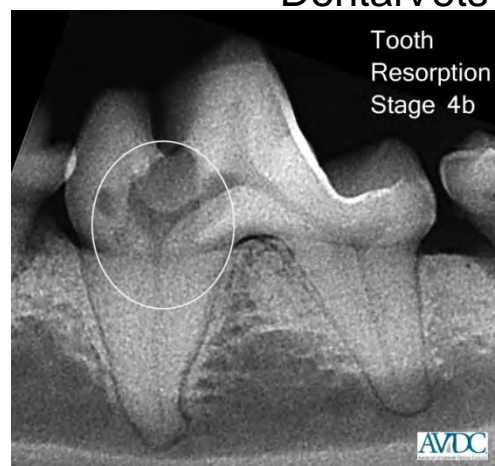
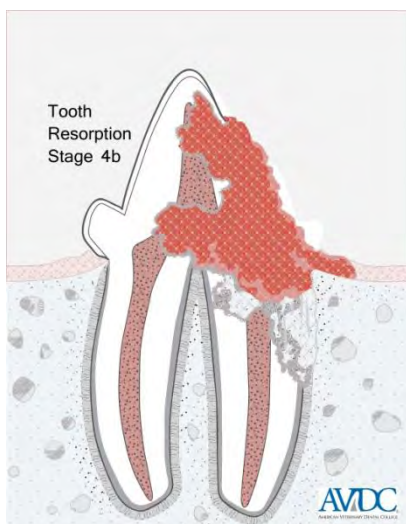
**Stage 4 (TR 4):** Extensive dental hard tissue loss (cementum or cementum and enamel with loss of dentin that extends to the pulp cavity); most of the tooth has lost its integrity.

*TR4a Crown and root are equally affected;*

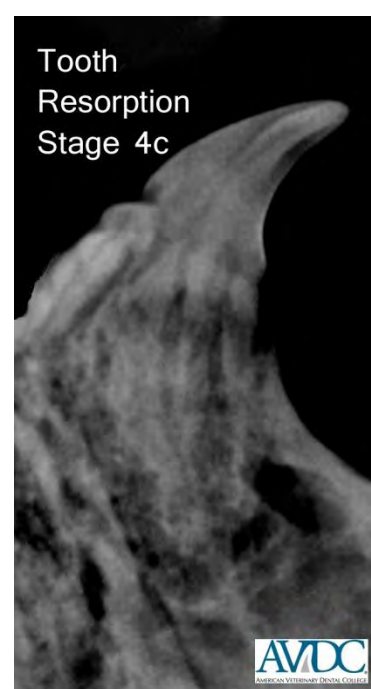
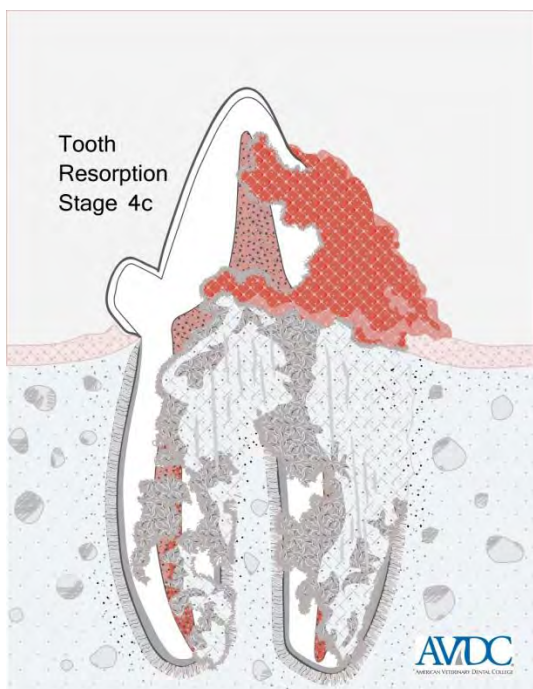


***TR4b Crown is more severely affected than the root;***

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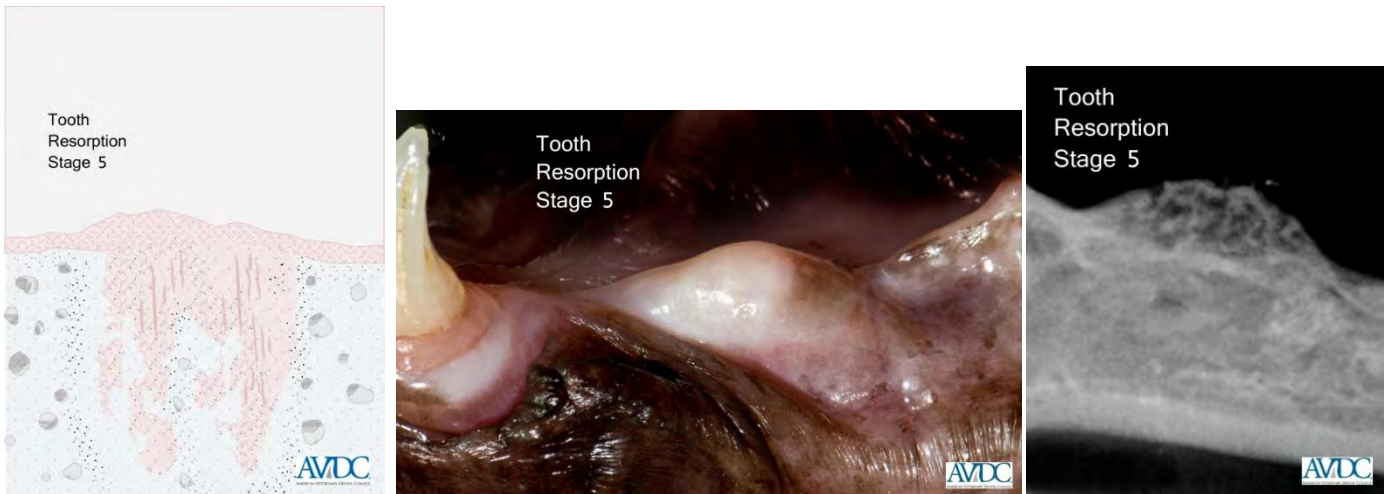


***TR4c Root is more severely affected than the crown.***





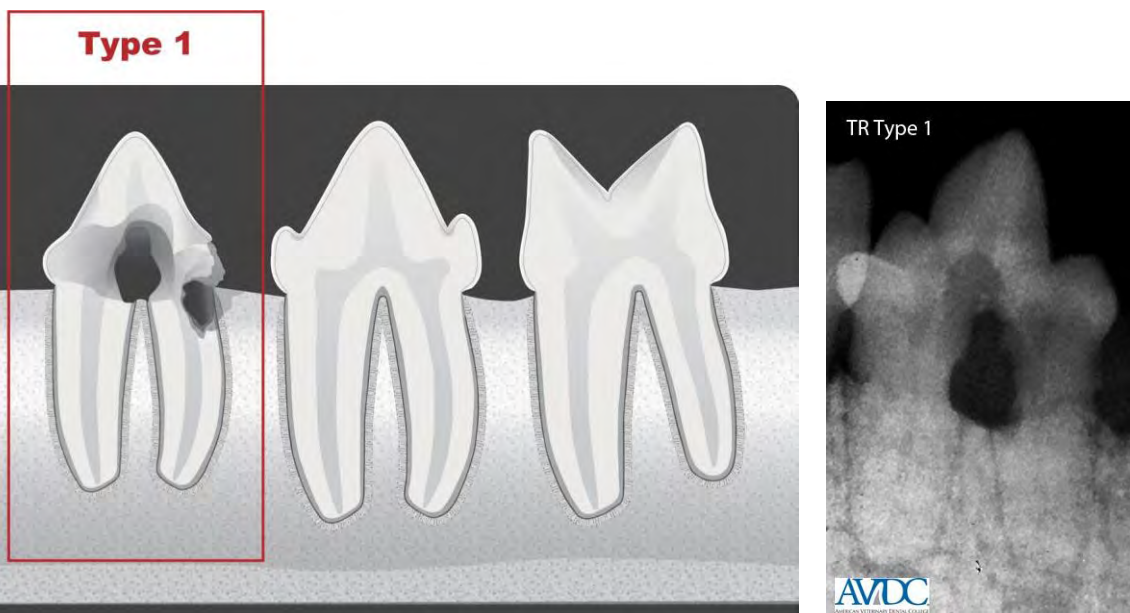
**Stage 5 (TR 5):** Remnants of dental hard tissue are visible only as irregular radiopacities, and gingival covering is complete. The oral mucosa may well have healed over the tooth fragments and may or may not be sensitive.



**Typing of Lesions**

Typing of Lesions is dependent on their location as seen on a radiograph. They can present in three ways:

**TYPE 1**

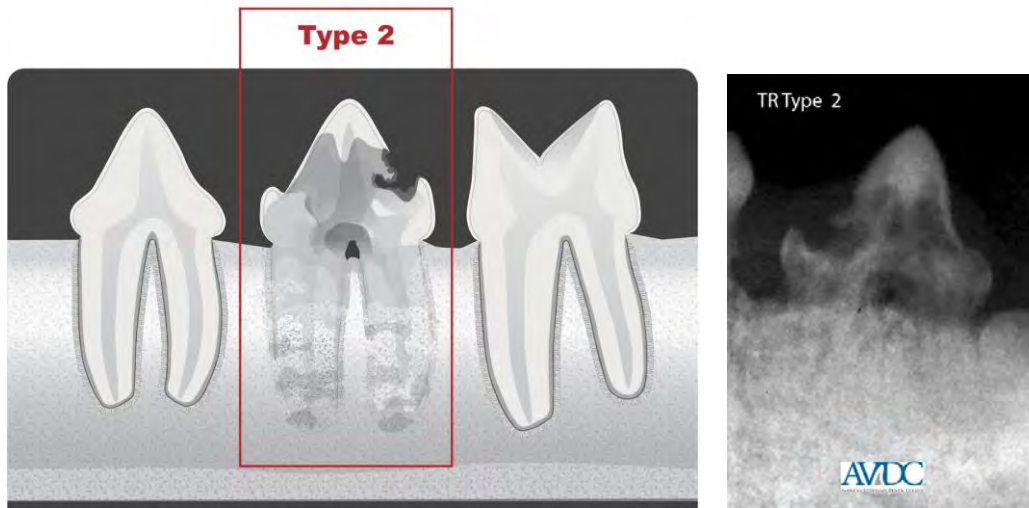


On a radiograph of a tooth with type 1 (T1) appearance, a focal or multifocal radiolucency is present in the tooth with otherwise normal radiopacity and normal periodontal ligament space. *(Du Pont 2002a)*

Concurrent periodontal disease is a common feature of type 1 lesions. *One study of 109 healthy cats indicated that 40% of the total lesions found were Type 1 (Girard 2008).*



## TYPE 2

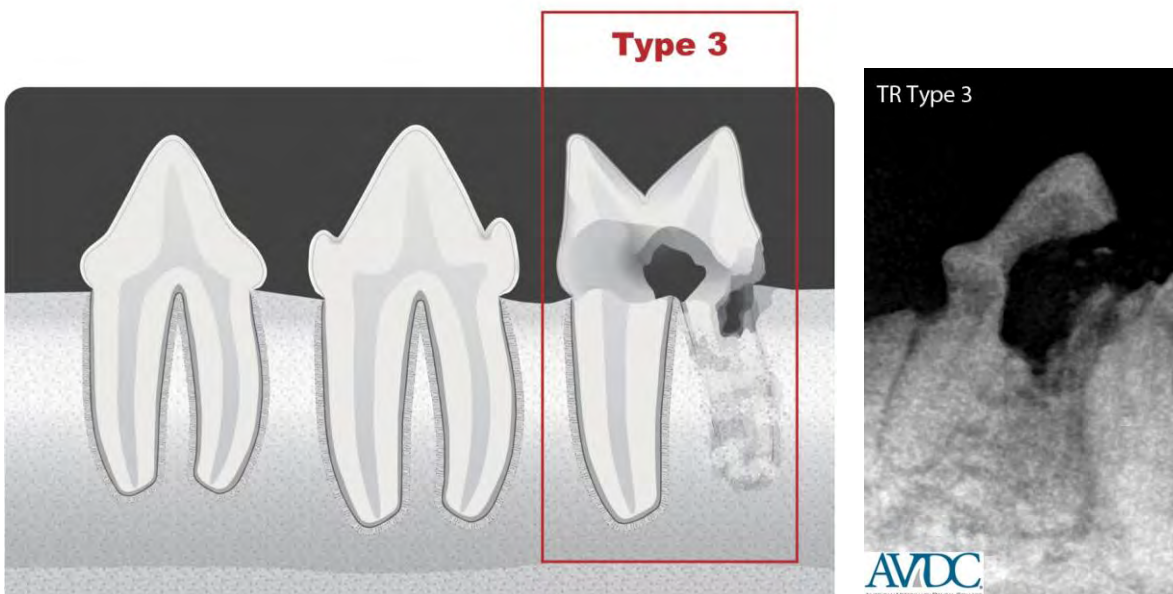


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On a radiograph of a tooth with type 2 (T2) appearance, there is narrowing or disappearance of the periodontal ligament space in at least some areas and decreased radiopacity of part of the tooth.

Type 2 lesions have extensive root replacement by alveolar bone. Progression will result in loss of periodontal ligament and pulp. *One study of 109 healthy cats indicated that 60% of the total lesions found were Type 2 (Girard 2008).*

## TYPE 3



On a radiograph of a tooth with type 3 (T3) appearance, features of both type 1 and type 2 are present in the same tooth. A tooth with this appearance has areas of normal and narrow or lost periodontal ligament space, and there is focal or multifocal radiolucency in the tooth and decreased radiopacity in other areas of the tooth.

## Summary of Staging and Typing

Correct staging and typing provides diagnosis, prognosis and treatment planning for that individual tooth. Bear in mind that a number of teeth may be affected and will be at different stages of progression. Some teeth may already be lost. Treatment planning, therefore, includes not only a strategy for the current period

but some form of monitoring for the future also.

*Abbreviations: A tooth with a Stage 4b lesion that has a type 2 radiographic appearance would be abbreviated TR-S4b-T2*

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## **Treatment of TR Lesions**

### **STAGE 1:**

Thorough dental scaling and polishing of the teeth with non-fluoride flour grade pumice. The affected tooth is lightly air-dried and treated with an unfilled resin dentine bonding agent (e.g. Bond One: Jeneric Pentron) to seal off the dentine tubules. Fluoride material such as Duraphat (Colgate) can also be used subsequently. It should be noted that the use of fluorides in this manner is mainly anecdotal and requires extreme care in small body weight animals. However, their action of hardening of enamel, desensitising exposed dentine and limiting the influence of plaque bacteria is likely to help patient comfort in the immediate post-op period. The teeth should be charted, radiographed **and re-examined by radiography at an interval of not more than three months**. The client is obviously made aware of the lesion and the need to introduce homecare methods to reduce the level of plaque on the crowns. Success rates of restoration of stage 1 lesions are considerably higher than for other stages (*Wiggs 2003*).

### **STAGE 2, 3 and 4:**

Stage 2 lesions and beyond are sensitive and most likely painful. They are treated by extraction (see below). The extraction technique used will be dependent on type as seen on radiograph.

- *Teeth with retained organic tissues (periodontal ligament and/or pulp – mainly Type 1) need to be extracted in a conventional manner via a mucogingival flap and buccal plate osteotomy before splitting into component roots. As these teeth are more fragile than “normal” teeth, more care is needed.*
- *Teeth with no organic material present (mainly Type 2) can be treated less invasively by crown amputation (coronectomy) via a small gingival envelope flap and crestal alveoplasty following extraction to eliminate any sharp bony margins.*
- *Treatment for Type 1 and Type 2 is not interchangeable. The less invasive technique for Type 2 is not suited to Type 1 and vice versa.*

**STAGE 5** - The stage 5 lesion consists of retained roots with no crowns. In many cases, these will be felt as hard swellings under healed oral mucus membranes. If there is no pathology of soft tissue over the swelling, no visible apical pathology on x-ray and no current sensitivity, no treatment is necessary. However, if soft tissue inflammation is present or if the cat feels pain or sensitivity in this area, exploration and curettage of the area may be desirable.

## **Extraction Techniques**

### **1. Conventional Extraction Technique (Type 1 lesions)**

Type 1 lesions are frequently linked with periodontal disease and a conventional extraction technique should be performed with the aim of removing all of the tooth tissue and diseased bone. It is not advisable to use a root retention technique with these teeth.

A mucogingival flap with vertical releasing incisions will provide superior visualisation of tooth and the buccal bone plate. The vertical releasing incisions should be made slightly off the target root(s) using a #11-scalpel blade along the dorsal/ventral axis of the mandible/maxilla and divergent to the long axis of the tooth. Make a gingival flap using a sharp periosteotome or periosteal elevator (Molt P2/4) to create good access to the target area.

Using a small round bur (#1) or diamond the buccal bone can be carefully removed to show the surface of the roots and the furcation point where they meet. Splitting the tooth into component roots can now take place. Further limited widening of the periodontal space can take place with the small bur before careful luxation of the roots with small luxators designed for this task. *See box below for recommended cat luxators.*

Once roots are removed the bone surface is smoothed with a rasp or rongeurs and flushed with sterile saline (10ml syringe/21g needle) before closure of flap with 5/0 Monocryl (*W 3203*).

### **Atomisation of cat teeth with a high-speed bur is not acceptable.**



This method of destroying the root does not give sufficient control and, in many cases, tissues beyond the root may be destroyed. Given that there is a sensory nerve beyond almost all teeth (infraorbital for maxilla or inferior alveolar nerve for the mandible,) it makes little sense to use this method. In normal circumstances, there is no substitute for careful elevation and removal of the whole root. The radiograph to the left shows the result of uncontrolled drilling. There are root remnants remaining and the mandible has almost been sectioned. The contents of the inferior alveolar canal have been shredded.

## **2. Crown Amputation Technique (Type 2 lesions)**

In the case of Type 2 lesions only, a technique of crown amputation is permissible (*Du Pont 2002a: Du Pont 2002*).

A limited envelope flap reflecting gingiva from the tooth surface using a periosteotome may be sufficient. If not, releasing incisions may occasionally need to be made if an envelope flap provides insufficient visualisation.

The crown is removed with a small (#1) round bur perpendicular to the long axis of the crown to remove all tooth structure to just below the level of the alveolar bone crest.

A fine round diamond or bone rasp should be used to create a smooth surface of bone before saline flushing and closure with single interrupted suture(s) of 5/0 Monocryl.

### **Dental Luxators for Cats**

Feline Luxator – EX5 (2mm)

Feline Luxator – EX5H (2mm notched)

Feline Luxator – EX5S (2mm serrated)

Feline Luxator – 100C (2mm gentle back curve)

Feline Root Tip Pick – WA1

**Source: [www.drshipp.com](http://www.drshipp.com)**

## SUMMARY

- The problem of feline tooth resorptive lesions can be demonstrated to affect at least 29% of the general cat population and at least 54% of those cats presented to veterinarians for oral cavity disease.
- The lower premolar 2's (307/407) act as sentinel teeth and provide a 93% predictor for lesions in other teeth.
- Treatment of TR's requires staging and typing by radiography to select the correct method.
- Bisphosphonate treatment (Alendronate: Merck) show promise to prevent progression of existing lesions and retard the formation of new lesions.

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