IJVAR

International Journal of Veterinary and Animal Research

Journal homepage: https://ijvar.org/index.php/ijvar

Clinical and Radiologic Evaluation of Dental Diseases in Cats

Nazlıcan Çelik✉, Birkan Karslı

Kırıkkale University, Faculty of Veterinary Medicine, Department of Surgery, Kırıkkale, Türkiye.

ARTICLE INFO

Received: 05/06/2024
Accepted: 20/03/2025

DOI: 10.5281/zenodo.15109879

✉**Corresponding Author:** nazlican.ccelik@gmail.com

Keywords

Dental radiography
Feline dental disease
Tooth resorption

Cite this article as: *Çelik N. and Karslı B. 2025. Clinical and Radiologic Evaluation of Dental Diseases in Cats. International Journal of Veterinary and Animal Research, 8(1): 12-17. DOI: 10.5281/zenodo.15109879.*

ABSTRACT

This study investigated the prevalence of dental diseases in cats, with a focus on the distribution of age and gender among effected individuals. A total of 50 cats were included, comprising 21 females (42%) and 29 males (58%). Age distribution revealed that 24 cats (48%) were kitten (0-11 months), 22 (44%) were adults (1-5 years), and 4 (8%) were elderly (≥6 years). Comprehensive clinical and radiographic evaluations were performed to assess the condition of the pulp, resorption, and the overall dental health, including the status of deciduous and permanent teeth, tooth mobility, dental plaque, halitosis, salivation, and mucous membrane appearance. The condition and number of deciduous and permanent teeth, mobility of teeth, dental plaque status, bad breath, salivation, and the appearance of mucous membranes were assessed. The findings showed that 44 cats (88%) presented with at least one dental disease, affecting a total of 125 teeth. Alarmingly, none of the owners practiced routine oral or dental care for their cats, and only a minority had any awareness of feline dental health. These results underscore the widespread neglect of oral hygiene in cats and highlight the urgent need for educational initiatives to improve awareness and management of feline dental health in the general population.

INTRODUCTION

Teeth (dentes) are the formations that enable the tearing, breaking, and crushing of foodstuffs into the mouth. They are the hardest anatomical formations of the body (Dursun, 1995). Domestic animals' morphology and dental configuration exhibit significant variations depending on the species. The formation of teeth is intricately linked to one's dietary habits. Carnivores possess pointed teeth designed for tearing or pulling, while herbivores have flatter teeth adapted for grinding or crushing. The teeth of carnivores also function as effective defensive weapons (Samsar and Akın, 2002).

Cats' most common dental diseases are feline odontoclastic resorptive lesions, periodontal disease, broken teeth, lost teeth, and persistent deciduous teeth. Tooth resorption, also known as feline odontoclastic resorptive lesion (FORL), neck lesions, and feline cavities, is a common condition for cats. Tooth resorption clinically affects slightly less than half of the feline population, according to the majority of studies. This figure can be elevated to 75% through the use of intraoral radiographs. The most significant consequences of tooth resorption are the resorption of the tooth and the proliferation of the gingiva or pulp to conceal the resulting lesion. The main symptom of tooth resorption is pain sensation (Holmstrom, 2013). The roots of deciduous teeth are typically resorbed as the permanent teeth erupt in dogs and cats from 14 weeks of age. Permanent teeth typically emerge at six months of age in the majority of dogs and cats. The mechanism that induces primary root resorption and the mechanism that prevents root resorption still need to be fully comprehended. One of the causes of deciduous tooth loss is the pressure generated by the eruption of the underlying permanent tooth during the eruption (Bellows, 2019).

Enamel and dentin loss are typically detectable on radiography due to crown fractures. A fracture line is visible between the tooth and the portion of the tooth that has not yet fully separated in crown and crown-root fractures. A root fracture may manifest in any region of the tooth. In incisive teeth, root fractures are typically transverse and oblique. Longitudinal crown-root fractures are less common than transverse and oblique fractures. In dogs and cats, root remnants are often seen on radiographs

(Reiter et al., 2018). While tooth fractures affecting the pulp are called complicated, tooth fractures where the pulp is not influenced are called uncomplicated crown fractures. Enamel is formed by cells called ameloblasts (Holmstrom, 2013). Defects in enamel formation may result from hereditary or inflammatory conditions during tooth development. Local inflammation can affect a single tooth, while systemic inflammation can affect all teeth. These events can induce microscopic changes, resulting in enamel hypoplasia, a condition characterized by a tooth with thin enamel that is susceptible to damage. Enamel hypoplasia is caused by insufficient levels of enamel matrix (Bellows, 2019). Periodontal disease is an inflammation and infection of the tissues surrounding the tooth, collectively called the periodontium (Holmstrom, 2013). The process of tissue destruction is caused by subgingival plaque, acute inflammation, and prostaglandin-induced bone resorption (Holmstrom et al., 2004). Plaque is a biofilm formed by glycolic bacteria and saliva. It is not easy to see unless stained using a long-wave ultraviolet light source and fluorescein. The stain darkens as the plaque thickness on the tooth surface increases. A tartar is a calcified deposit made up of minerals that come from saliva. Tartar is predominantly found on the outer side of molars and premolars, as well as on the inner side of incisors near the openings of salivary ducts (Lane, 1981).

Pulpitis may be either reversible or irreversible. Sometimes, pulpitis can lead to dystrophic mineralization of the pulp, which can result in the pulpal cavity being completely lost or narrowed in a localized area. This dystrophic mineralization is not to be confused with pulp stones, which are intrapulpal mineralized structures that are unrelated to the current disease (Reiter and Gracis, 2018). Anodontia, the lack of teeth, can occur in cats and dogs. Teeth may be missing because they never developed in the first place, erupt slowly, or are present but fall out (Holmstrom, 2013). Dental radiographs should be taken in animals suspected to be missing some teeth (Tutt, 2006). Supernumerary teeth are typically observed in incisive teeth; however, the entire tooth may be supernumerary. Supernumerary teeth can result in the misplacement of other teeth, the failure of teeth to erupt, or the accumulation of severe plaque and periodontal disease (Holmstrom, 2013).

The aim of this study is to identify dental problems by performing radiographic and clinical examinations of the oral cavity and dental diseases in cats brought to clinics with dental problems or other complaints.

MATERIALS AND METHODS

Permission was obtained from the “Kırıkkale University Clinical Practices Ethics Committee”, and the animal owners were informed about the study, and informed consent and anesthesia authorization form was obtained for this study. The study used 50 cats of different breeds, ages, sexes, and reasons for complaints in Kırıkkale University Faculty of Veterinary Medicine. All of the patients went through clinic and radiological examination. A standardized dental examination form (Figure 2) was developed to streamline data collection and analysis. This form included information on patient's age, breed, sex, current home care practices, diet, and specific complaints. The anesthesia protocol and the clinical and radiological procedures required for the detailed examination were explained the owner beforehand.

For the examination, anesthesia was induced with 40 µg/kg medetomidine (Domitor, Finland, Zoetis) and 5 mg/kg ketamine HCL (Ketasol, Austria, Interhas), administered intramuscularly. An endotracheal tube was used to intubate patients who were under general anesthesia. All through the anesthesia, patients were administered intravenously 5-10 ml/kg/h of 0.9% isotonic solution.

The patient underwent a comprehensive clinical examination under anesthesia. Assessment included the condition and number of deciduous and permanent teeth, tooth mobility, dental plaque, mucous membranes appearance, salivation, and halitosis. The examination form was utilized to document the clinical examination findings. Findings from the clinical examination were documented using a standardized examination form. Following administration of appropriate anesthetic doses, the patient was positioned for radiographic imaging. In order to image maxillary premolars and molars, the film was placed flat along the palatine and the x-ray was sent laterally at 45° angle (Niemec, 2014). While using bisecting angle technique, arcus zygomaticus maxillary 4th premolar, 1st molar and even maxillary 3rd premolar distal root from being imaged. That is the reason why extra oral technique was used here. The film was placed on the table. The area of the patient to be imaged was positioned facing downwards, and the x-ray was sent at an approximately 30° angle (Loprise et al., 2019).

For maxillary canines and inciciv tooth, the x-ray tube and film were positioned in a parallel technique, then the x-ray tube was given a rostro-caudal at an angle of either 20 or 70° Niemec, 2015). In order mesial root of the maxillary 4th premolar, the tube head was positioned at the degree 45 angle in the vertical plane. It was then rotated approximately at a 30° distally in the horizontaly plane (Niemec, 2015).

While imaging mandibulary canine and inciciv tooth, the patient was put in the ventrodorsal position. Parallel technique was used for mandibular molar and caudal premolar radiographs (Volker, 2019). A 90° angle was used for mandibular premolars and molars. Niemec, 2014) Radiographs were taken using parallel, simplified, bisecting angle technique ans extra-oral techniques (Figure 1). The examination form was also utilized to evaluate and document pulp status and the presence of resorption observed in the radiographic images (Figure 2).

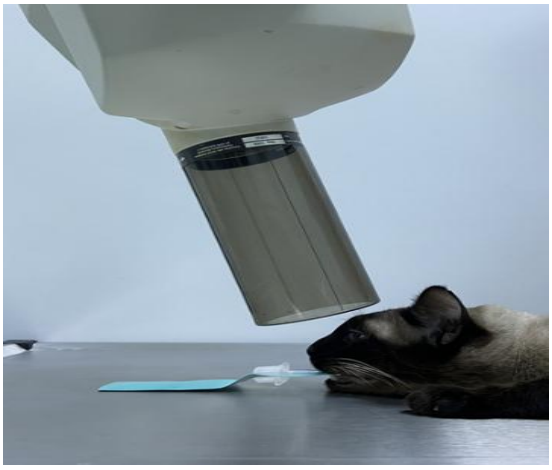

Figure 1. Visualization of maxillary canine and incisive teeth

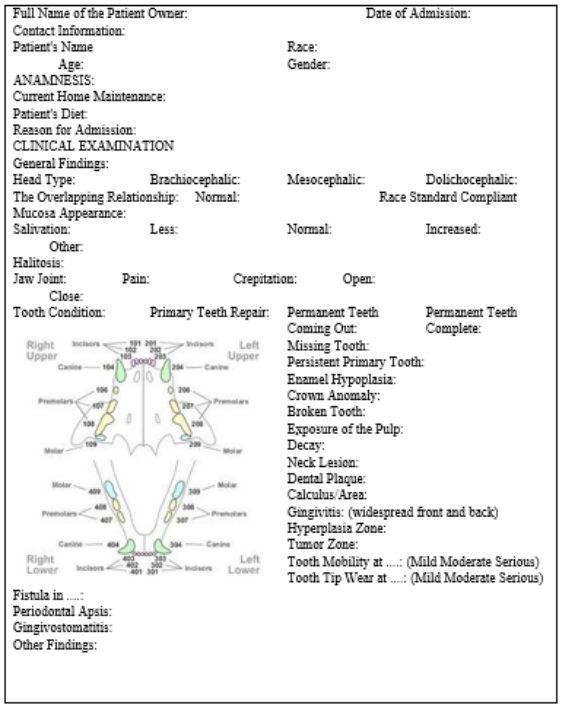
Full Name of the Patient Owner: Date of Admission:
Contact Information:
Patient's Name Race:
Age: Gender:
ANAMNESIS:
Current Home Maintenance:
Patient's Diet:
Reason for Admission:
CLINICAL EXAMINATION
General Findings:
Head Type: Brachiocephalic: Mesocephalic: Dolichocephalic:
The Overlapping Relationship: Normal: Race Standard Compliant
Mucosa Appearance:
Salivation: Less: Normal: Increased:
Other:
Halitosis:
Jaw Joint: Pain: Crepitation: Open:
Close:
Tooth Condition: Primary Teeth Repair: Permanent Teeth Coming Out: Permanent Teeth Complete:
Missing Tooth:
Persistent Primary Tooth:
Enamel Hypoplasia:
Crown Anomaly:
Broken Tooth:
Exposure of the Pulp:
Decay:
Neck Lesion:
Dental Plaque:
Calculus/Area:
Gingivitis: (widespread front and back)
Hyperplasia Zone:
Tumor Zone:
Tooth Mobility at ....: (Mild Moderate Serious)
Tooth Tip Wear at ....: (Mild Moderate Serious)
Fistula in ....:
Periodontal Apsis:
Gingivostomatitis:
Other Findings:

Figure 2. Dental examination form

RESULTS

Data related to the sex and age of the cats used in the research is shown on the table (Table 1).

Table 1. Percentage of disease based on age and sex

Sex and Age Group	Number of Cats Examined	Number of Cats with Disease Detected	Percentage of Disease
Female	21	18	85,7%
Male	29	26	89,6%
Kitten (0-11 mounths old)	24	20	83,3%
Adult (1-5 years old)	22	20	90,9%
Elder (+6 years old)	4	4	100%

Clinical and radiologic examination revealed disease in 44 of 50 cats and 125 teeth in total. There were 31 cases in canines, 22 in incisives, 50 in premolars, and 22 in molars. Most cases of persistent deciduous teeth were seen in canines (Figure 3), while cases of missing teeth were seen in incisives, premolars, and molars (Table 2).

Table 2. Disease distribution based on tooth types

	1st Degree Tooth Resorption	2nd Degree Tooth Resorption	3rd Degree Tooth Resorption	4th Degree Tooth Resorption	5th Degree Tooth Resorption	Missing Tooth	Persistent Deciduous Tooth	Crrown Non-complicated Fractured	Crown Complicated Fractured	Complicated Root Fractured	2nd Degree Plaque	3rd Degree Plaque	4th Degree Plaque	Discolorization
Canin Teeth	-	-	-	-	-	-	16	6	5	-	4	-	-	-
Inciciv Teeth	-	-	1	2	-	19	-	-	-	-	-	-	-	-
Premolary Teeth	1	1	1	2	-	18	-	-	-	1	2	3	13	1
Molary Teeth	1	1	7	1	2	8	-	-	-	-	1	-	1	-

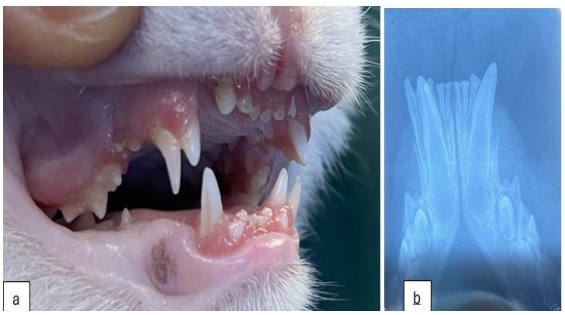

Figure 3. Persistent deciduous tooth case (a) and radiographic image (b)

Periodontal disease was the most prevalent condition, affecting 16 patients. In 14 patients, tooth resorption followed periodontal disease (Figure 4). After radiological examination, loss of density was seen in 14 cats in various tooth (Table 3). The number of cats with broken teeth was 8. 4 of these cats were male, and 3 were female. Of the cats with fractured teeth, 5 were kittens, 2 were adults and 1 was elderly. 11 fractured teeth were canine, and 1 was premolar (Figure 5). After radiographic examination, it was found that 3 cats had uncomplicated crown fractures without pulp exposure, 4 cats had complicated crown fractures, and 1 cat had complicated crown-root fractures. (Table 3) Out of the 11 fractured canine teeth, 6 of them were uncomplicated cron fractures, and 5 of them were

complicated crone fractures. Whereas, complicated cron root fracture was seen in the fractured premolar teeth. Out of the 11 fractured canine teeth, 6 of them were uncomplicated cron fractures, and 5 of them were complicated crone fractures. Whereas, complicated cron root fracture was seen in the fractured premolar teeth. Periodontal disease was seen in 16 of the cats used in the study. Of these cats, 5 were female and 11 were male. 6 of the cases were kittens, 8 were adults, and 2 were elderly. Dental tartar was encountered in 10 of the cats. Of these, 4 were females, 6 were males, 2 were kittens, 7 were adults, and 1 was elderly. 2 cats were level 2, 2 cats were level 3, and 6 cats were level 4. Tartar was seen on 24 teeth in total. Of these teeth, 4 were canines, 18 were premolars, and 2 were molars. A total of 9 cats had cases of missing teeth. Of these cats, 4 were females and 5 were males. Of the cats with missing teeth, 2 were kittens, and 7 were adults. A total of 45 missing teeth were detected in 9 cases. Of these teeth, 19 were incisors, 18 were premolars, and 8 were molars. Spotting was observed in 4 of the cats used in the study. 3 of these cats were male, and 1 was female. 2 of the cats were kittens, and 2 were adults. In these 4 cases, staining was seen in a total of 7 teeth, all of which were premolars. Discoloration of premolar teeth was detected only in 1 kitten and 1 female cat. In addition, an intraoral mass was detected in 1 adult female cat (Figure 6) (Table 3).

Table 3. Disease distribution based on age

	Disease	Number of Cats with Disease Detected	Kitten	Adult	Elder
1	Tooth Resorption	14	3	8	3
	1st Degree	1	-	1	1
	2nd Degree	2	-	2	-
	3rd Degree	9	3	4	2
	4th Degree	4	-	3	1
	5th Degree	2	-	2	-
2	Missing Tooth	9	2	7	-
3	Supernumerary Tooth	-	-	-	-
4	Persistent Deciduous Tooth	6	6	-	-
5	Enamel Hypoplasia	-	-	-	-
6	Fractured Tooth	8	5	2	1
	Enamel Fractured	-	-	-	
	Non-complicated Crown Fractured	3	1	1	1
	Complicated Crown Fractured	4	3	1	-
	Non-complicated Crown – Root Fractured	-	-	-	-
	Complicated Crown – Root Fractured	1	1	-	-
	Root Fractured	-	-	-	-
	Plaque	10	2	7	1
	1st Degree	-	-	-	
	2nd Degree	2	-	2	-
	3rd Degree	2	1	1	-
	4th Degree	6	1	4	1
8	Pulpitis	-	-	-	-
10	Discolorization	1	1	-	-
11	Periodontal Disease	16	6	8	2
	1st Degree	3	2	1	-
	2nd Degree	2	1	2	-
	3rd Degree	6	1	3	2
	4th Degree	5	2	3	-
12	Oral Neoplasia	1	-	1	-

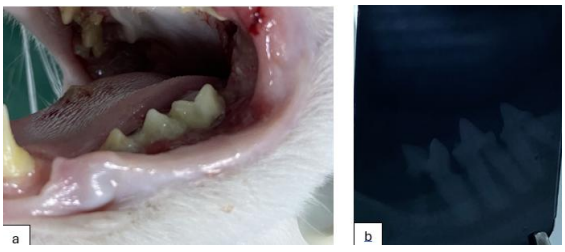

Figure 4. A case of resorption in a mandibular molar (a) and its radiologic appearance (b)

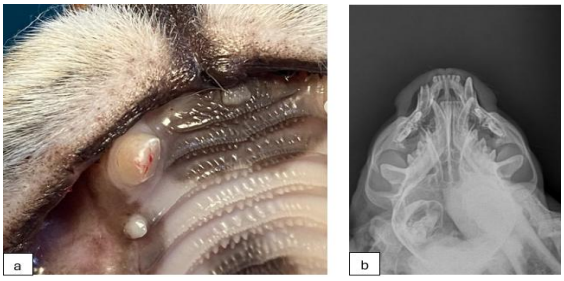

Figure 5. A case of a fractured canine tooth (a) and its radiologic appearance (b)

Figure 6. Intraoral mass

It was determined that none of the cases received any oral or dental health care during their daily lives.

DISCUSSION AND CONCLUSION

In a study of 18.249 cats in the United Kingdom, dental diseases were found to be the 3rd most common disease in cats (O'Neill et al., 2023). The literature review found that the incidence of dental diseases in cats increases with age (Larsen, 2010). In the study, 83% of kittens, 90% of adult cats, and 100% of older cats had the disease.

In diagnosis of dental diseases, the importance of dental radiographics is significant, but the radiograph must be interpreted correctly. Factors like bone density, pulpa's condition and monitoring periodontal ligament must be carefully evaluated (Martinez et al., 2022). Radiological imaging was used in all cats in the submitted research. Dental radiographs supported in diagnosing many diseases especially tooth resorption and fractured tooth as well as shaping the proper treatment.

Tooth resorption is commonly seen in cats and radiographic imaging is crucial to diagnose it. Even a very detailed dental examination may not be 100% affective for tooth resorption (Lobprise et al., 2019). Studies have determined that the prevalence of tooth resorption in cats ranges from 28 to 67% (Karslı and Pekcan, 2020). Nevertheless, the disease was not influenced by age or gender; however, it was more prevalent in older cats; tooth resorption was reported in 16% of cats under 6 years of age and 74% of cats over 6 years of age (Coles, 1990, Pistor et al., 2023). Other studies found that premolars and molars had the most common lesions (Pistor et al., 2023), while Ingham et al.'s study on 228 cats found symmetrical resorption cases most frequently in teeth numbered 307 and 407 (Ingham et al., 2001). In the study, we identified Resorption cases in 28% of the cats. Adult patients accounted for 57% of resorption cases, while elderly patients accounted for 21%. The most prevalent type of dental resorption was observed in molars, with most cases being symmetrical and occurring in teeth with numbers 309 and 409. Althouhg there are a couple of theories, the reason for tooth resorption is not known yet. Different theories have been put forward, such as high levels of vitamin D or the abfraction injuries that are caused by violation in dry food diets (Schaer et al., 2019). According to another theory, tooth resorption is caused by the acids occurred while vomiting furball (Holmstrom, 2013). Considering these theories, it can be thought that it is more common in older cats, because the time the cat is exposed to the mentioned situations increases at the same rate as it gets older.

Tutt (2006) has reported that the persistence of mandibular and maxillary canine teeth in cats is uncommon in comparison to dogs. According to another study, persistent deciduous teeth are also more common in dogs, especially in small and miniature breeds (Schaer et al., 2019). A comparison between cats and dogs was not possible due to the absence of dogs in the study, and persistent deciduous teeth were observed in 12% of the cats used in the study. The canine teeth were the only persistent deciduous teeth observed, and all of the cats were between 0 and 11 months old.

The reported prevalence of periodontal disease in cats ranged from 13.9% to 96%. Although many risk factors such as breed, age, sex, and body weight have been reported for periodontal disease in dogs, the literature is very limited in cats (O'Neill et al., 2023). A study conducted in France revealed that Persian and Maine coon cats were more susceptible to periodontal disease. Conversely, other studies could not determine the prevalence of mongrel or purebred cats due to insufficient results (Girard et al., 2009; Lommer et al., 2001). The literature review showed that gender and neutering status were not associated with periodontal disease in cats (Girard et al., 2009). Periodontal disease was observed in 32% of the cats used in the study. No breed discrimination was observed. In the present study, 61% of the 18 cats with periodontal disease were male. But it would not be correct to say that male cats are predisposed just with these results.

In a study conducted in North America, it was reported that the incidence of dental tartar in cats of all ages was 13-24% (Lund et al., 1999). In this study, dental tartar was seen in 20% of the cats. Of the cats with dental tartar, 2 were kittens, 7 were adults and 1 was an elderly cat.

There is a lack of substantial literature regarding feline enamel hypoplasia, pulpitis, supernumerary teeth, lost teeth, and fractured teeth. The majority of the research was conducted on dogs. The frequency of dental diseases in cats, the distribution of age and sex, and the practices of home care were all examined in this study. Although at least one disease was identified in 88% of the cats that participated in the study, it was noted that none of the owners provided home care for oral and dental health. Nearly none of them had any knowledge. It is thought that oral and dental health needs to be sufficiently emphasized in our country, and patient owners need to be informed. We veterinarians have a great job in this regard. The quality of life of a cat is significantly diminished by its poor oral and dental health. Simple home applications can be implemented to safeguard dental and oral health. Particularly when the patient is accustomed to oral care during kittenhood, the patient will permit the care to be administered without causing any issues for the owner in adulthood.

In conclusion, it was observed that dental diseases in cats increase with age. It is also thought that inadequate oral care is effective in this situation. Males were more likely to have dental diseases than females, but since there was no significant difference, gender is not thought to have an effect on dental diseases. Through comprehensive literature reviews, it has been noted that there needs to be more sufficient oral and dental research specifically focused on cats compared to dogs. It was determined that

Turkish patient owners should be educated about oral and dental health. Dental diseases are widely prevalent in cats, and as they advance, they result in intense pain, decreased appetite, and rapid deterioration of overall health.

Acknowledgement

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Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: B.K., N.Ç., **Design:** N.Ç., **Data Collection or Processing:** B.K., N.Ç., **Analysis or Interpretation:** N.Ç., **Literature Search:** N.Ç., **Writing:** B.K., N.Ç.

Financial Support

This research received no grant from any funding agency/sector.

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