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## A RETROSPECTIVE LOOK AT THE PREVALENCE OF DENS INVAGINATUS IN CLIENT-OWNED DOGS

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Özgür BİLGİÇ<sup>1</sup>, Elif BİLGİR<sup>2</sup>

### ABSTRACT

**Objectives:** The oral cavity is considered a gateway to the body because dental disease may result in many systemic conditions. Dogs and cats are sporadically affected by developmental dental anomalies and dens invaginatus is one such anomaly. Dens invaginatus predisposes the affected tooth to caries and endodontic infection. The purpose of this study was twofold: (a) to determine the number of missing teeth and (b) to detect the prevalence of dens invaginatus in dogs and to discuss its clinical importance

**Methods:** In this retrospective study, we investigated the prevalence of dens invaginatus. All of the existing maxillary and mandibular teeth were examined clinically and radiographically in order to determine the number of missing teeth and the presence of dens invaginatus.

**Results:** Of the 188 mandibular first molar teeth examined three (1.6%) of them were identified to have dens invaginatus.

**Conclusion:** Even if the anomalous teeth may not seem to cause any pathology at the time they are first discovered, they need to be followed up periodically for any developing pathology as early intervention will prevent occurrence of severe complications. Full-mouth intraoral radiography has a tremendous role in the diagnosis and follow-up of patients with anomalous teeth.

**Keywords:** *Dens invaginatus, dog, intraoral radiography, veterinary dentistry*

<sup>1</sup> DVM, FAVD, DipABVP, Smith and Shedd Family Pet Hospital, San Antonio, Texas, United States of America, [bilgic\\_ozgur@hotmail.com](mailto:bilgic_ozgur@hotmail.com), ORCID: 0000-0002-2781-2311

<sup>2</sup> DDS, PhD, Associated Professor, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Eskişehir Osmangazi University, Eskişehir –Turkey, [bilgirelif04@hotmail.com](mailto:bilgirelif04@hotmail.com), ORCID: 0000-0001-9521-4682

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## SAHIPLİ KÖPEKLERDE DENS İNVAJİNATUS SIKLIĞININ RETROSPEKTİF OLARAK İNCELENMESİ

### ÖZ

**Amaç:** Diş hastalıkları birçok sistemik hastalıkla bağlantılı olduğundan ağız boşluğu vücuda açılan bir kapı olarak kabul edilir. Gelişimsel diş anomalileri kediler ve köpekleri sıklıkla etkilemektedir, dens invaginatus da bu anomalilerden biridir. Dens invaginatus, etkilenen dişi çürük ve endodontik enfeksiyona yatkın hale getirir. Bu çalışmanın amacı iki yönlüydü: (a) köpeklerde diş eksikliklerini belirlemek ve (b) dens invaginatus prevalansını saptamak ve klinik önemini tartışmak.

**Metod:** Bu retrospektif çalışmada, köpeklerde dens invaginatus prevalansı araştırıldı. Eksik diş sayısı ve dens invaginatus varlığının tespiti için mevcut maksiller ve mandibular dişlerin tamamı klinik ve radyografik olarak incelendi.

**Bulgular:** İncelenen 188 mandibular birinci molar diştten üçünde (%1.6) dens invaginatus varlığı tespit edildi.

**Sonuç:** Anomalili dişler ilk keşfedildikleri anda herhangi bir patolojiye neden oluyor gibi görünmese bile, erken müdahale ciddi komplikasyonların oluşumunu önleyeceği için gelişen herhangi bir patolojiye karşı periyodik olarak takip edilmeleri gerekir. Bu amaçla full mouth ağız içi radyografları, anomalili dişleri olan köpeklerin tanı ve takibinde büyük bir role sahiptir.

**Anahtar Kelimeler:** *Dens invaginatus, köpek, ağız içi radyografi, veteriner diş hekimliği*

### 1.INTRODUCTION

Oral health is an integral part of the general health of pet dogs. As more veterinarians are interested and trained in veterinary dentistry, the number of identified dental pathologies is increasing every year. Besides, more dog owners are asking for dental assessment and treatment for their dogs, which contributes to the ever-growing need for veterinary dental care. Oral diseases can cause serious problems such as chronic pain, infection, halitosis, tooth loss, and decreased or absent appetite. One of the most common causes of dental pain in dogs is pulpal infection and inflammation. Tooth fractures, blunt trauma, extension of periodontal disease, and developmental anomalies can all result in pulpal disease [1-3].

Dens invaginatus, a developmental dental malformation, may result in pulpal infection in dogs. Dens invaginatus is characterized by an infolding of the enamel and dentin into the pulp chamber forming a pocket inside the affected tooth. The enamel lining the coronal defect may have poor quality (thin, porous, etc) or some areas of the defect may even lack the enamel layer. Even if an obvious opening of the invagination cannot be distinguished, a relatively thin wall may separate the pocket from the pulp chamber creating an opening into the oral cavity [3, 4]. It is very difficult to keep the invagination pocket clean using routine homecare and, consequently, the area of invagination becomes a site of stagnation for oral bacteria thus creating a favorable environment for caries development. Such carious lesions are difficult to detect clinically and will rapidly involve the pulp. In some cases, invagination and pulp chamber communicate through very small canals. This may lead to pulpal infection in the absence of carious lesions.

Dens invaginatus has been described in the veterinary literature involving the mandibular first molars and a maxillary canine [1, 3-5]. However, to our knowledge, there are no studies in the literature investigating the prevalence of dens invaginatus in dogs.

The purpose of this study was twofold: (a) to determine the number of missing teeth and (b) to detect the prevalence of dens invaginatus in dogs and to discuss its clinical importance.

## 2.MATERIAL AND METHODS

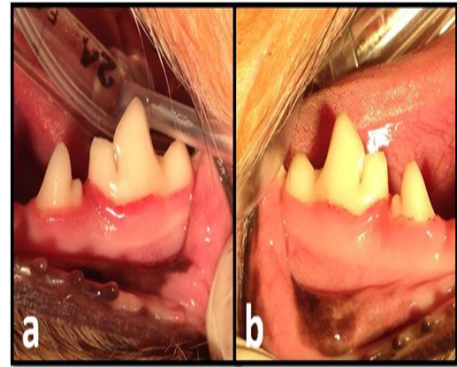
This retrospective study was performed by examining the clinical oral pictures and full mouth intraoral radiographs of 100 dogs that were admitted to Town and Country Veterinary Hospital, San Antonio, Texas, USA, for a comprehensive oral health assessment and treatment between 2014-2015. VetPro® DC Digital Dental Radiography System, U.S.A, with variable kVp (60, 65 and 70) and mA (4, 5, 6 and 7) was used to obtain the dental radiographs. Only adult dogs were included in the study, and dogs with deciduous or mixed dentition were left out. Clinical oral pictures of the dogs have been kept as a part of their medical records and obtained from the patient database. Poor quality radiographs and radiographs that did not show all of the existing teeth of an individual dog were excluded. All dental radiographs were evaluated by the same clinician (Ö.B.) under the same conditions.

The gender (61 females and 39 males, altered or not) and the breed of the dogs were recorded. All of the maxillary and mandibular teeth were evaluated in order to determine the number of missing teeth and the presence of dens invaginatus. The number of missing teeth were determined based on the standard tooth formula of the permanent dentition of the dog. The number and localization of the missing teeth were recorded.

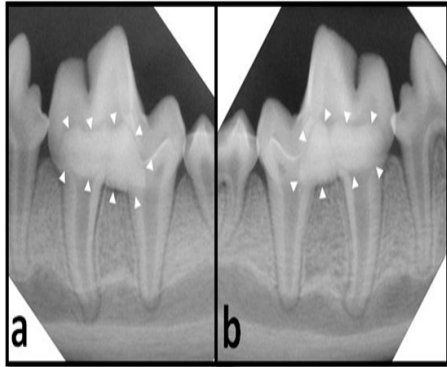
## 3.RESULTS

Of the 100 dogs, the three most common breeds evaluated were; 1) mixed breed, 2) Miniature Dachshund, and 3) Shih Tzu. Forty-two of the 100 dogs screened in this study had full set of their adult dentition. In the remaining 58 dogs, the total number of missing teeth was 332.

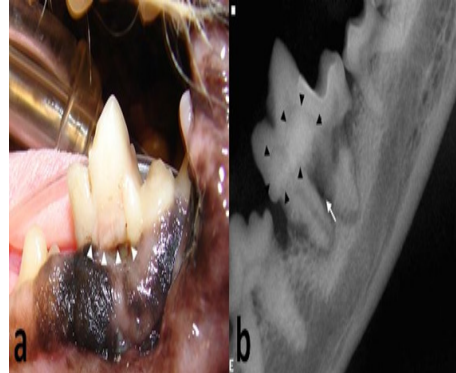
Within the scope of the study, a total of 3868 teeth were examined. Dens invaginatus was detected in 2 (2%) of the 100 dogs. Both of these cases were mixed breed dogs. The mandibular first molars were the only type of teeth that had dens invaginatus. One dog's both mandibular first molars were affected by this condition (Figure 1A, 1B, 2A, and 2B). The other dog's left mandibular first molar had dens invaginatus (Figure 3A and 3B). However, the right mandibular first molar was missing in this dog. Three (1.6%) of the 188 mandibular first molar examined were found to have dens invaginatus. The presence of dens invaginatus was shown in Table 1.



**Figure 1:** Oral photographs showing the mandibular left (309) [a] and right (409) [b] first molars. No obvious enamel abnormalities are seen. Only mild marginal gingivitis is present in both teeth



**Figure 2:** Intraoral dental radiographs of the mandibular left (309) [a] and right (409) [b] first molar showing abnormal radiodensities associated with the crown (arrowheads). No sign of endodontic disease (periapical radiolucent areas associated with the roots) is evident at this time



**Figure 3:** Oral photograph [a] of the mandibular left (309) first molar showing the abnormal enamel (white arrowheads). Intraoral dental radiograph [b] of the same tooth showing abnormal radiodensities within the crown (black arrowheads), converging roots, wide root canals (compared with those of neighboring teeth), severe periodontal bone loss, and furcation exposure (white arrow).

**Table 1: Prevalance of the dens invaginatus**

		Examined Subjects	Dens Invaginatus	Prevalance (%)
Mandibular	First Molar Tooth	188	3	1.6
<b>Total Dog</b>		100	2	2

#### 4.DISCUSSION

The level of dental care for dogs and cats has increased significantly as more owners became aware of the devastating local and systemic consequences of dental disease. The oral cavity is considered a gateway to the body because dental disease may have many systemic consequences such as decrease in liver and kidney function, valvular dysplasia, endocarditis, thromboembolic disease, cerebral and myocardial infarctions, chronic obstructive respiratory disease, pneumonia, insulin resistance, and an abnormal immune response to pathogens. The gold standard of veterinary oral health care involves clinical oral examination, examination under anesthesia, dental charting, full-mouth intraoral radiography, dental prophylaxis, and treatment tailored for individual teeth based on the present pathology [2].

Dental radiology is a fundamental diagnostic tool for oro-dental diseases. Many dogs do not show clinical signs of dental disease until the pain becomes unbearable or their mouth cannot function. Therefore, most of the oral diseases can only be diagnosed in the late stages when the owners just notice the oral problem of their dogs. Dental radiography helps to detect hidden pathological conditions that are present underneath the gingival margin [6, 7]. Periodontal disease, caries, endodontic disease, resorptive lesions, fractures and neoplastic conditions require radiographs for more accurate diagnosis [8]. A previous study shows that dental radiography provides additional and clinically useful information about dental diseases in 72% of dogs [9]. The routine use of full intraoral radiography is recommended due to the high sensitivity in detecting dental diseases compared to selective radiography [9]. Currently, it is well established in veterinary medicine full mouth radiographs [9, 10]. Several studies have been performed to evaluate the diagnostic value of intraoral radiography, but no study has focused on investigating one single developmental anomaly [9, 11]. In a study that evaluated

8308 teeth, radiographic abnormalities were detected in 29.6% of the teeth. Additional and important diagnostic information was obtained in 84.8% of teeth with radiographic evidence of dental pathology. The prevalence of abnormal radiographic findings in each tooth in this study was significantly lower than previously reported (72.0%) [1]. The difference in the prevalence between these two studies may be due to the different assessment methods used in each study. Among the predetermined 16 categories of abnormal radiographic findings, dens invaginatus was seen in 0.1% of the 8308 teeth evaluated.

In order to differentiate the cause of missing teeth as congenital or acquired, dental radiography is essential. Kim et al. [1] stated that acquired missing teeth were most commonly seen in the first premolars and second and third molars. This may be due to severe dental pathologies affecting these sites more frequently and resulting in the extraction of the aforementioned teeth. In contrast, congenitally missing teeth were most commonly observed in the right mandibular first premolars [12].

Developmental abnormalities of the teeth are relatively rare. When present, they can lead to various pathological conditions such as periodontal disease, endodontic disease, osteomyelitis, anorexia and discomfort [3]. Dens invaginatus is characterized by an invagination of the enamel and dentin into the pulp chamber of the affected tooth. The exact cause remains unclear, but it has been regarded as a potential cause of endodontic disease [13]. The defect may be limited to crowns or may include crowns and roots. The area of intussusception can be covered with thin, incomplete or irregular enamel, which makes it susceptible to various pathological condition, including caries, pulp infection, and periapical disease [14-16]. These complications can arise because the area where the intussusception takes place can accommodate many irritants such as bacteria, food and epithelial cells.

The constant ingress of irritants and resulting inflammation may cause pulp necrosis that often results in periapical pathology [17].

Dens invaginatus, first described in 1855, has been classified by several researchers [18, 19]. The most widely accepted classification scheme was proposed in 1958. Type I is an invagination confined within the tooth crown, type II is an invagination that invades the pulp chamber and the root with no communication, and type III is an invagination that extends through the root and exits the root apically or laterally [19]. An important feature of dens invaginatus is that it can have a large number of thin channels connecting the invagination with the pulpal cavity (18, 20, 21). This abnormal communication pathway with the pulp is the cause of frequent pulpal involvement (18, 20).

The etiology of dens invaginatus is not clear. (1, 4, 14, 16, 17). Descriptive terms include dens in dente(22), dilated composite odontom (23), gestant anomaly (22), and dens invaginatus (18, 19). Theories for the invagination include: apical proliferation of ameloblasts, locally arrested enamel development, enamel organ invagination during development, rapid proliferation of the cells of the inner enamel epithelium, external influences such as trauma, inadequate nutritional status, and defective ameloblastic function (20, 21). Hypotheses regarding the etiology include external forces on the tooth bud during development such as nearby tooth buds, trauma, infection, focal growth acceleration, and tooth bud retardation (24). To our knowledge, there is no study reporting the prevalence of dens invaginatus in dogs. Therefore, the purpose of this study was to determine the prevalence of dens invaginatus in a sample of dogs. In humans, the reported prevalence of the teeth affected by dens invaginatus is between 0.3% and 10% with the problem occurring in 0.25% to 26.1% of the patients examined (25-27).

In the present study, dens invaginatus was observed in three of the 188 mandibular first molar teeth with a prevalence of 1.6%.

Any of the teeth in the maxilla and mandible may be affected, but there are few cases of dogs reported in the literature. Mandibular first molars appear to be more commonly affected in dogs. In our study, the three teeth that were affected by this condition were also mandibular first molars.

The symmetry of dens invaginatus has been considered to be a common finding by some authors. Dens invaginatus has been reported to have possible association with other dental anomalies such as microdontia, gemination, fusion, and taurodontism (28, 29). In our study, one of the two patients with dens invaginatus had the condition bilaterally (in both right and left mandibular first molars). The other patient's left mandibular first molar was affected. However, the right mandibular first molar was missing and there was no history of extraction. We hypothesized that this patient also had the condition bilaterally, but with the advancement of endodontic disease to combined endodontic-periodontal disease, the right mandibular first molar had lost its periodontal attachments and fallen off at some point of time. Extraction of the left mandibular first molar was performed in this patient due to severe destruction of the periodontal attachment. No treatment was performed on the dog that had the condition bilaterally per the owner's request. However, periodic monitoring with dental radiographs was recommended to the owner in order to detect any related complications early on.

Dens Invaginatus was identified in only mixed breed dogs in this study. It is not clear why only mixed breed dogs had this anomaly in this study, but the condition was reported in the purebred dogs such as Jack Russell Terrier and German Shepherd in the literature.



Because the condition is a developmental anomaly it is present in the affected dogs since the development of adult dentition, however clinical signs associated with this condition can manifest at any point in the dog's life.

There are several treatment options for invaginated teeth. Tooth function, periodontal status of the tooth, root canal system configuration, and economic considerations are some factors that should be taken into account when choosing a treatment modality. Treatment options for dens invaginatus include exodontia, conventional or surgical root canal therapy, and obliteration of the invagination followed by root canal therapy [3-5, 14-16]. Extraction is an appropriate treatment option for teeth with endodontic or combined endodontic-periodontal lesions [3, 5]. Affected teeth with evidence of periapical disease can be treated with conventional or surgical root canal therapy. If there is no sign of endodontic disease and no obvious communication of the invagination is detected, the tooth can be monitored and re-x-rayed every six months to a year [4].

## CONCLUSION

Several reports from the veterinary literature and these authors' experiences suggest that mandibular first molars are a common site for occurrence of dens invaginatus in dogs. Even if the anomalous teeth may not seem to cause any pathology at the time they are first discovered, they need to be followed up periodically for any developing pathology as early intervention will prevent occurrence of severe complications such as periodontal disease and endodontic death. Full-mouth intraoral radiography has a tremendous role in the diagnosis and follow-up of patients with anomalous teeth.

## Conflicts of Interest

The authors has no conflicts of interest to article.

## Acknowledgments

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## REFERENCES

1. Kim C-G, Lee S-Y, Kim J-W, Park H-M. Assessment of dental abnormalities by full-mouth radiography in small breed dogs. *Journal of the American Animal Hospital Association*. 2013;49(1):23-30.
2. Colmery B, 3rd. The gold standard of veterinary oral health care. *Vet Clin North Am Small Anim Pract*. 2005;35(4):781-7, v.
3. Stein KE, Marretta SM, Eurell JAC. Dens invaginatus of the mandibular first molars in a dog. *Journal of veterinary dentistry*. 2005;22(1):21-5.
4. Coffman CR, Visser CJ, Visser L. Endodontic treatment of dens invaginatus in a dog. *Journal of veterinary dentistry*. 2009;26(4):220-5.
5. Duncan HL. Diagnostic Imaging in Veterinary Dental Practice. *Journal of the American Veterinary Medical Association*. 2010;237(11):1251-3.
6. Mulligan T AM, Williams CA. . Atlas of canine and feline dental radiography. (NJ) T, editor1998.
7. Woodward TM. Dental radiology. *Topics in companion animal medicine*. 2009;24(1):20-36.
8. Gorrel C. Radiographic evaluation. *Vet Clin North Am Small Anim Pract*. 1998;28(5):1089-110.
9. Verstraete FJ, Kass PH, Terpak CH. Diagnostic value of full-mouth radiography in dogs. *Am J Vet Res*. 1998;59(6):686-91.
10. Tsugawa AJ, Verstraete FJ. How to obtain and interpret periodontal radiographs in dogs. *Clinical techniques in small animal practice*. 2000;15(4):204-10.
11. Tsugawa AJ, Verstraete FJ, Kass PH, Görrel C. Diagnostic value of the use of lateral and occlusal radiographic views in comparison with periodontal probing for the assessment of periodontal attachment of the canine teeth in dogs. *Am J Vet Res*. 2003;64(3):255-61.

12. Harvey CE EP. Small animal dentistry. St. Louis (MO): Mosby; 1993.
13. Gallacher A, Ali R, Bhakta S. Dens invaginatus: diagnosis and management strategies. *British Dental Journal*. 2016;221(7):383-7.
14. Eden EK, Koca H, Sen BH. Dens invaginatus in a primary molar: report of case. *ASDC J Dent Child*. 2002;69(1):49-53, 12.
15. Gound TG. Dens invaginatus--a pathway to pulpal pathology: a literature review. *Pract Periodontics Aesthet Dent*. 1997;9(5):585-94; quiz 96.
16. Chen YH, Tseng CC, Harn WM. Dens invaginatus. Review of formation and morphology with 2 case reports. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1998;86(3):347-52.
17. Kulild JC, Weller RN. Treatment considerations in dens invaginatus. *J Endod*. 1989;15(8):381-4.
18. Rotstein I, Stabholz A, Heling I, Friedman S. Clinical considerations in the treatment of dens invaginatus. *Endod Dent Traumatol*. 1987;3(5):249-54.
19. Oehlers F. Dens invaginatus (dilated composite odontome): I. Variations of the invagination process and associated anterior crown forms. *Oral Surgery, Oral Medicine, Oral Pathology*. 1957;10(11):1204-18.
20. Wells DW, Meyer RD. Vital root canal treatment of a dens in dente. *J Endod*. 1993;19(12):616-7.
21. Ruprecht A, Sastry KA, Batniji S, Lambourne A. The clinical significance of dental invagination. *JPedod*. 1987;11(2):176-81.
22. Colby RA KD, Robinson HBG. . Color atlas of oral pathology. Philadelphia: JB Lippincott; 1961.
23. Hunter HA. Dilated composite odontome; reports of two cases, one bilateral and one radicular. *Oral Surg Oral Med Oral Pathol*. 1951;4(5):668-73.
24. Peyneau PD, da Costa ED, Verner FS, de Freitas DQ, Almeida SM, Ambrosano GMB. Cone beam computed tomography in the diagnosis of dens invaginatus: Case report. *International journal of odontostomatology*. 2017;11(1):89-94.
25. Thakur S, Thakur NS, Bramta M, Gupta M. Dens invagination: A review of literature and report of two cases. *Journal of natural science, biology, and medicine*. 2014;5(1):218.
26. Coraini C, Mascarello T, de Palma CM, Gobbato EA, Costa R, de Micheli L, et al. Endodontic and periodontal treatment of dens invaginatus: report of 2 clinical cases. *Giornale Italiano di Endodonzia*. 2013;27(2):86-94.
27. Alani A, Bishop K. Dens invaginatus. Part 1: classification, prevalence and aetiology. *International endodontic journal*. 2008;41(12):1123-36.
28. Hamasha AA, Alomari QD. Prevalence of dens invaginatus in Jordanian adults. *International endodontic journal*. 2004;37(5):307-10.
29. Kirzioglu Z, Ceyhan D. The prevalence of anterior teeth with dens invaginatus in the western Mediterranean region of Turkey. *International endodontic journal*. 2009;42(8):727-34.