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Oronasal and Oroantral Fistulas Secondary to Periodontal Disease: A Retrospective Study Comparing the Prevalence Within Dachshunds and a Control Group

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Abstract

The prevalence of oronasal and oroantral fistulas (ONF/OAF) was retrospectively identified in a population of dachshund patients (dachshund group) and was compared to a population of small breed dogs of significantly similar age and weight (control group). When compared with the control group, the dachshund group was significantly more likely to have an ONF/OAF ($P < .0001$). The odds ratio indicates that dachshunds were 3.3 times more likely to have an ONF/OAF than individuals within the control group. This study statistically confirms previous reports and clinical observations that dachshunds are predisposed to ONF/OAFs. When ONF/OAFs are present, the maxillary canines are the most commonly affected dentition in both study groups.

Keywords

oronasal, oroantral, fistula, dachshund, periodontal, nasal, extraction, disease, veterinary, dentistry

Introduction

An oronasal fistula (ONF) is an abnormal communication between the oral and nasal cavities.[1] An oroantral fistula (OAF) is an abnormal communication between the oral cavity and the maxillary recess.[2] The maxillary recess is located adjacent to the maxillary dentition distal to the maxillary third premolar.[2]

Oronasal and oroantral fistulas secondary to periodontal disease are a common clinical finding in the canine species that may result in clinical signs consistent with rhinitis: face rubbing, snorting, sneezing, reverse sneezing, epistaxis, and nasal discharge (serous to mucopurulent).[2-6]

It has been suggested that ONF/OAFs secondary to periodontal disease are common in small breed dogs and that the dachshund breed appears to be predisposed.[2-4,7-9] Also, it is reported that when ONFs are present, maxillary canine teeth are frequently affected.[2,3,6,9]

The intent of this study is to identify the prevalence of ONF/OAFs within a population of dachshund patients (dachshund group) and compare these findings to a population of dogs of similar age, weight and sex (control group). It is the authors' hypothesis that the dachshund group would have a significantly higher prevalence of ONF/OAFs compared to a control group comprised of small breed dogs of similar age, weight and sex.

Materials and Methods

This retrospective study identified 2 groups: the dachshund group (dachshund patients) and the control group (small breed dogs of similar age, weight and sex).

To create a dachshund group, the practice database was searched for all dachshunds (including all patients identified as dachshund, miniature dachshund, and long-haired miniature dachshund) that presented between 2007 and 2017 for an oral evaluation under general anesthesia. No other phenotypic variations of the dachshund breed were noted in the database. Patient signalment including age, weight, sex, and neuter status was recorded. For each patient, the presence and location of any ONF/OAFs on the dental chart was tabulated.

To create a control group, the practice database was searched in reverse chronological order, over the previous 12 months, for canine patients that presented for an oral evaluation under general anesthesia. Only patients within the age and weight range of the dachshund group were included in the study. The recording process was the same as that of the dachshund group. Patients included within the dachshund group were excluded from the control group.

All patients had a complete oral health assessment under general anesthesia, which included full mouth intraoral radiographs and periodontal probing. The gingival sulcus of each tooth was evaluated with a periodontal probe (UNC-15[a]) at 6

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Table 1. Table depicting the prevalence of patients with at least 1 ONF/OAF, and of those patients, the prevalence of patients with 2 or more ONF/OAF.

Group	Patients With at least 1 ONF/OAF	Patients With 2 or more ONF/OAF (of those patients with at least 1 ONF/OAF)
Dachshund group (n = 91)	43/91 (47.3%)	27/43 (62.8%)
Control group (n = 127)	27/127 (21.3%)	15/27 (55.5%)

Abbreviation: ONF/OAF, oronasal and oroantral fistula.

locations (mesiobuccal, buccal, distobuccal, distolingual or palatal, lingual or palatal, and mesiolingual or palatal). When maxillary teeth were extracted, the alveolus was again evaluated for an ONF/OAF with a periodontal probe.

The study was designed to exclude patients that had pathology other than periodontal disease that resulted in ONF/OAFs, such as neoplasia, maxillofacial trauma, electrical injuries, and so on. No patients met these criteria. Patients with ONF/OAFs that were not associated with the dental arch, such as congenital cleft palate and acquired palatal defects, were not included in the study.

Statistical Analysis

Computer software[b] was used to perform all statistical analysis. Continuous data were summarized with mean and range. Two-sample *t* test was used to evaluate associations between categorical variables (age and weight). Pearson χ^2 test was used to evaluate associations between prevalence of ONF/OAFs between groups, associations of sex distribution between groups, and analysis between male and female subsets of the population. Logistic regression analysis was used to evaluate associations of the variable of age and the prevalence of ONF/OAFs between groups. Values of $P < .05$ were considered significant.

Results

Ninety-one client owned dachshunds comprised of 43 (47.3%) of 91 neutered males, 45 (49.5%) of 91 spayed females, 2 (2.2%) of 91 intact males, and 1 (1.1%) of 91 intact females were identified. The mean patient age was 8.9 years (range: 2-18 years), and the mean patient weight was 5.7 kg (range: 2.1-11.0 kg). Within the dachshund group, at least one ONF/OAF was identified in 43 (47.3%) of 91 patients (Table 1). Of those patients recorded as having an ONF/OAF, 27 (62.8%) of 43 were noted to have 2 or more ONF/OAF (Table 1). The right and left maxillary canines (104 and 204) were the most commonly affected dentition with ONFs identified in 35 (38.5%) of 91 and 31 (34.1%) of 91 patients, respectively. Of those patients with ONF/OAFs, 31 (72.1%) of 43 had an ONF associated with at least one maxillary canine. Oronasal fistulas were also associated with the right maxillary first premolar (105): 2 (2.2%) of 91; right maxillary third premolar (107): 1 (1.1%) of 91; left maxillary first incisor (201): 1 (1.1%) of 91; left maxillary third incisor (203): 1 (1.1%) of 91; left maxillary first premolar (205): 2 (2.2%) of 91; left maxillary second premolar (206): 1 (1.1%) of 91; and left maxillary third premolar (207): 1 (1.1%) of 91. Oroantral fistulation was associated with the left maxillary fourth premolar (208): 3 (3.3%) of 91 (Figure 1).

Figure 1. A miniature dachshund patient with a chronic oronasal fistula in the location of the previously extracted left maxillary canine (204). A periodontal probe is placed through the nasoalveolar defect into the nasal cavity.

One hundred twenty-seven client owned canine patients that consisted of 59 (46.5%) of 127 neutered males, 62 (48.8%) of 127 spayed females, 3 (2.4%) of 127 intact males, and 3 (2.4%) of 127 intact females comprised the control group. The mean patient age was 8.8 years (range: 2-16 years), and the mean patient weight was 5.6 kg (range: 2.3-10.3 kg). Within the control group, at least one ONF/OAF was identified in 27 (21.3%) of 127 patients (Table 1). Of those patients recorded as having an ONF/OAF, 15 (55.5%) of 27 were noted to have 2 or more ONF/OAFs (Table 1). The right and left maxillary canines (104 and 204) were the most commonly affected dentition with ONFs identified in 15 (11.8%) of 127 and 13 (10.2%) of 127 patients, respectively (Figure 1). Of those patients with ONF/OAFs, 13 (48.1%) of 27 had an ONF associated with at least one maxillary canine. Oronasal fistulas were also associated with the right maxillary third incisor (103): 1 (0.8%) of 127, right maxillary first premolar (105): 3 (2.4%) of 127, right maxillary second premolar (106): 6 (4.7%) of 127, left maxillary third incisor (203): 2 (1.6%) of 127, left maxillary first premolar (205): 2 (1.6%) of 127, and left maxillary second premolar (206): 2 (1.6%) of 127. Oroantral fistulation was associated with the right maxillary fourth premolar (108): 1 (0.8%) of 127 (Figures 1 and 2).

The dachshund group was significantly more likely to have an ONF/OAF than the control group ($P < .0001$). The odds ratio indicates that dachshunds were 3.3 times more likely to have an ONF/OAF than individuals within the control group (95% confidence interval). These findings confirm the authors' hypothesis that the dachshund group would have a significantly higher prevalence of ONF/OAFs than a control group comprised of small breed dogs of similar age and weight.

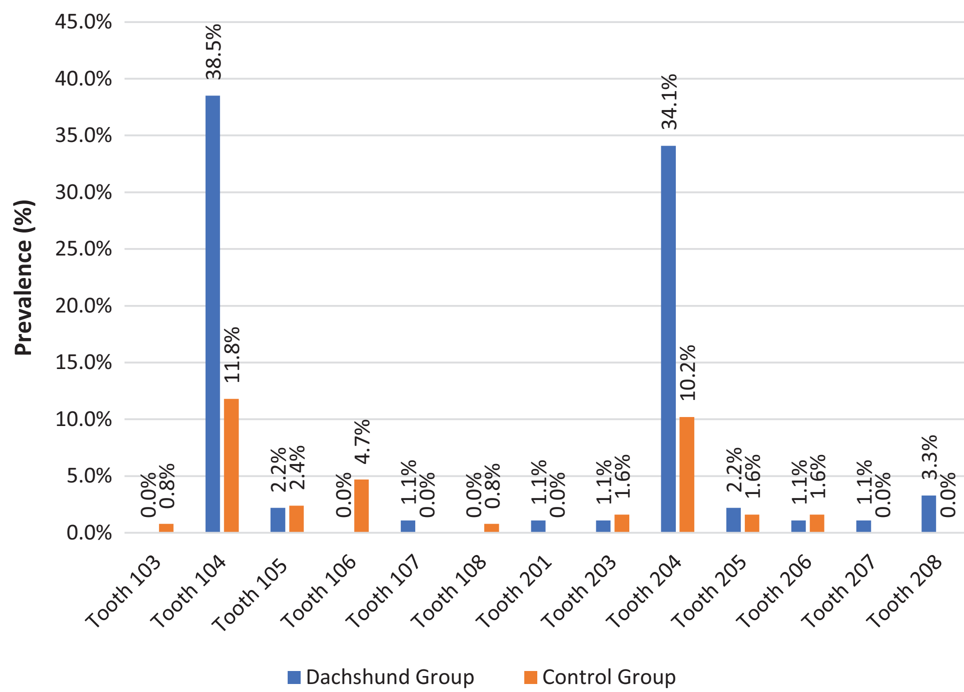

Figure 2. Comparison of the prevalence of oronasal and oroantral fistulas for specific teeth within the dachshund and control groups. Note: Teeth not represented were not associated with ONF/OAF within either group. ONF/OAF indicates oronasal and oroantral fistula.

There were no significant differences in age ($P = .518$), weight ($P = .569$) or sex distribution ($P = 0.924$) between the dachshund and control groups. When the study groups were pooled (dachshund and control groups combined), increasing age was a significant risk factor for ONF/OAFs ($P = .028$).

When the study groups were evaluated independently, there was no significant difference in the prevalence of ONF/OAFs between males and females in the dachshund group ($P = .117$). Also, there was no significant difference in the prevalence of ONF/OAFs between males and females in the control group ($P = .608$). When comparing the male subsets between the study groups (dachshunds and control groups), the male dachshund subset was significantly more likely to have an ONF/OAF than the male control subset ($P < .0001$). The odds ratio indicates that male dachshunds were 5.2 times more likely to have an ONF/OAF compared to individuals within the male control subset (95% confidence interval). When comparing the female subsets between the study groups (dachshund and control groups), there was no statistically significant difference between female subsets, although there was a trend that would likely manifest with a larger sample size ($P = .068$). The odds ratio indicates that female dachshunds were 2.1 times more likely to have an ONF/OAF compared to individuals within the female control subset (95% confidence interval; Figures 3A-C, 4A-C, and 5A-C).

The dachshund group had a total of 78 ONF/OAFs. The control group had a total of 45 ONF/OAFs. The relative frequency of ONF/OAFs within the dachshund and control groups is summarized in Figures 6A and B and 7A and B; these figures demonstrate the frequency in which an individual tooth was associated with an ONF/OAF when comparing it to the total number of ONF/OAFs identified within each study group.

Discussion

Oronasal and oroantral fistulas can be congenital or acquired.[10] Congenital ONF/OAFs are represented by primary and secondary cleft palate.[10] Acquired ONF/OAFs can present as a defect within the dental arch, hard palate, and soft palate. Advanced periodontal disease associated with the maxillary dentition is the most common cause of ONF/OAFs; this is due to the nasal cavity and dentition being separated by a thin layer of bone.[2,3,6,9,11-14] Acquired ONF/OAFs are reported to be commonly associated with the palatal surface of the maxillary canine teeth, which is consistent with the results of the current study.[2,3,6,9]

Recognizing that periodontal disease is the most common cause of acquired ONF/OAFs, alternative etiologies may include iatrogenic injury that manifests during tooth extraction, including avulsion of a portion of the palatal alveolar wall with the tooth during extraction, displacement of the tooth apex through the palatal alveolar wall during extraction, and exposure of nasoalveolar defects following extraction; postsurgical complications following procedures involving the palatine, incisive, and maxillary bones; iatrogenic surgical trauma; maxillofacial trauma; gunshot wounds; unsuccessful cleft lip/palate repair; neoplasia; electrical injury; eosinophilic granuloma; radiation therapy; pressure necrosis; complications associated with nasopharyngeal stents; and penetrating wounds.[1,4-6,15-18]

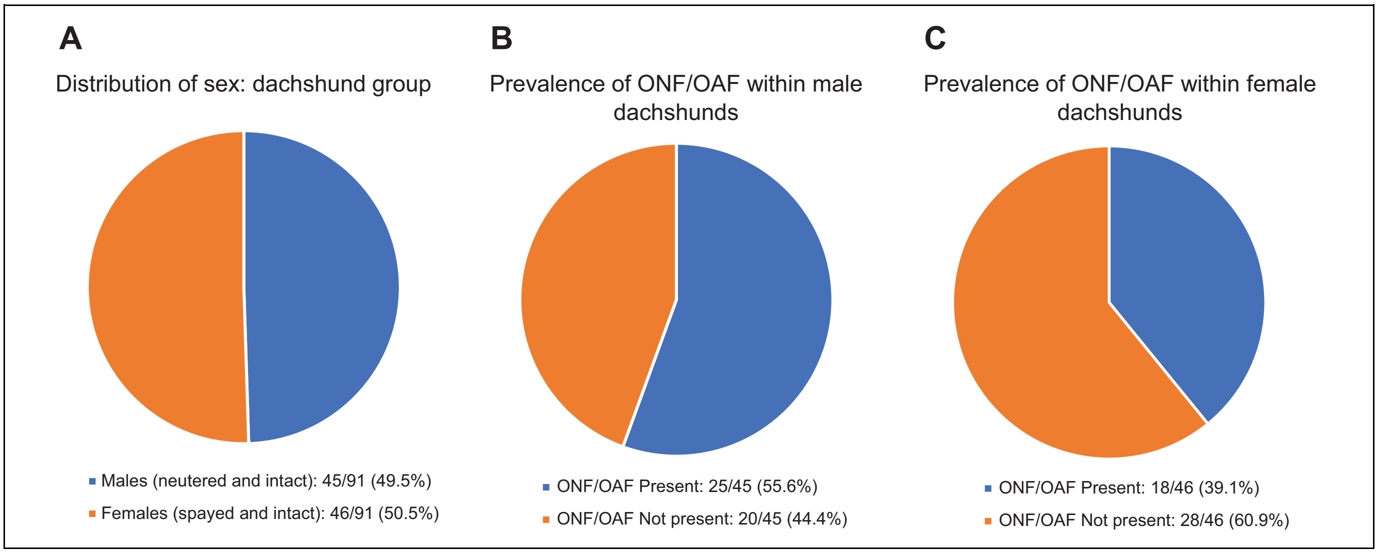

Figure 3. The distribution of sex within the dachshund group (A). The prevalence of ONF/OAF within male dachshunds (B). The prevalence of ONF/OAF within female dachshunds (C). ONF/OAF indicates oronasal and oroantral fistula.

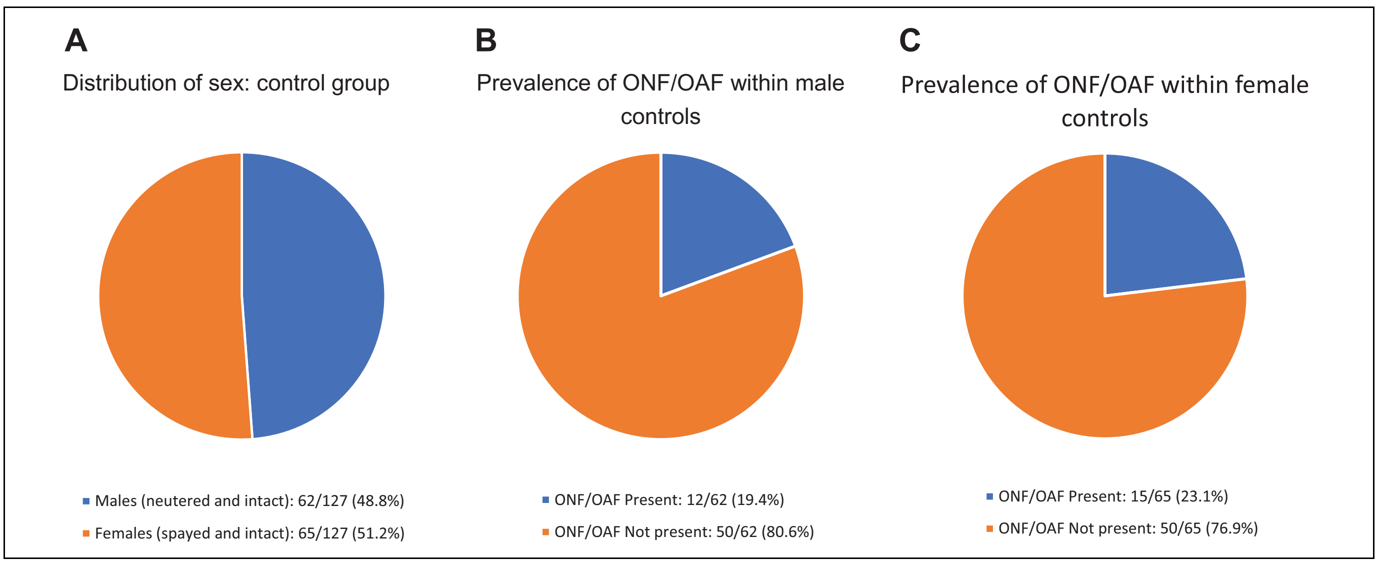

Figure 4. The distribution of sex within the control group (A). The prevalence of ONF/OAF within male control subset (B). The prevalence of ONF/OAF within female control subset (C). ONF/OAF indicates oronasal and oroantral fistula.

Periodontal disease is described as the loss of attachment of the periodontium, which is comprised of the gingiva, cementum, alveolar bone, and the periodontal ligament.[19,20] Attachment loss is quantified by the sum of gingival recession and periodontal pocket measurements.[21] The formation of ONF/OAF on the palatal surface of the maxillary dentition is a common sequela to periodontal disease.[2,3,6,9]

Although some patients with ONF/OAFs are asymptomatic, many exhibit clinical signs consistent with rhinitis: face rubbing, snorting, sneezing, reverse sneezing, epistaxis, and nasal discharge (serous to mucopurulent).[2-6] If ONF/OAFs are not identified and repaired, intercavity communication allows movement of oral flora, food, debris, hair, water, and saliva into the nasal cavity.[2] Consequently, chronic inflammation and infection of the nasal tissue occurs. Failure to diagnose ONF/OAFs can result in a potentially unnecessary diagnostic workup for nasal disease involving cross-sectional imaging (computed tomography) and rhinoscopy. A previous study demonstrated that diseases associated with the dentition are a common underlying etiology of nasal disease; the authors identified infections of odontogenic origin to be the likely cause of idiopathic lymphoplasmacytic rhinitis in 55% of patients evaluated.[3] Large defects may predispose patients to aspiration pneumonia, particularly congenital defects such as cleft palate.[4,22,23]

Oronasal and oroantral fistulas are diagnosed on clinical examination, not radiographic examination.[2,24] Fistulations secondary to periodontal disease are suspected when deep

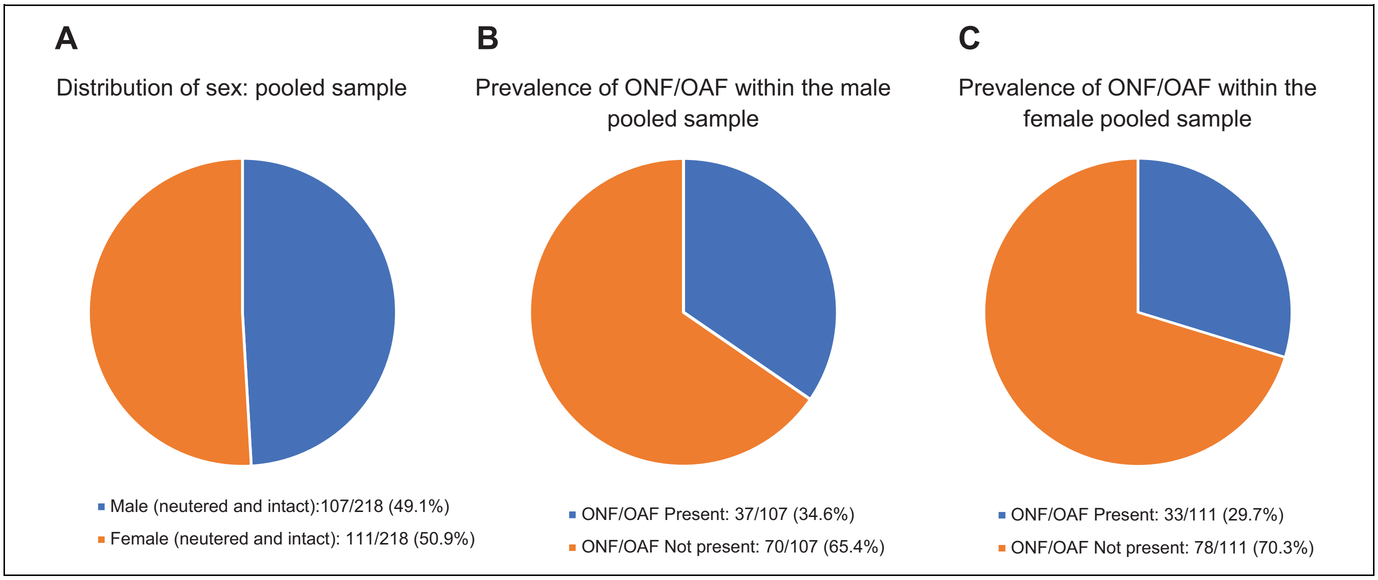

Figure 5. The distribution of sex within the pooled group (both dachshund and control groups; (A). The prevalence of ONF/OAF within the male pooled population (B). The prevalence of ONF/OAF within female pooled population (C). ONF/OAF indicates oronasal and oroantral fistula.

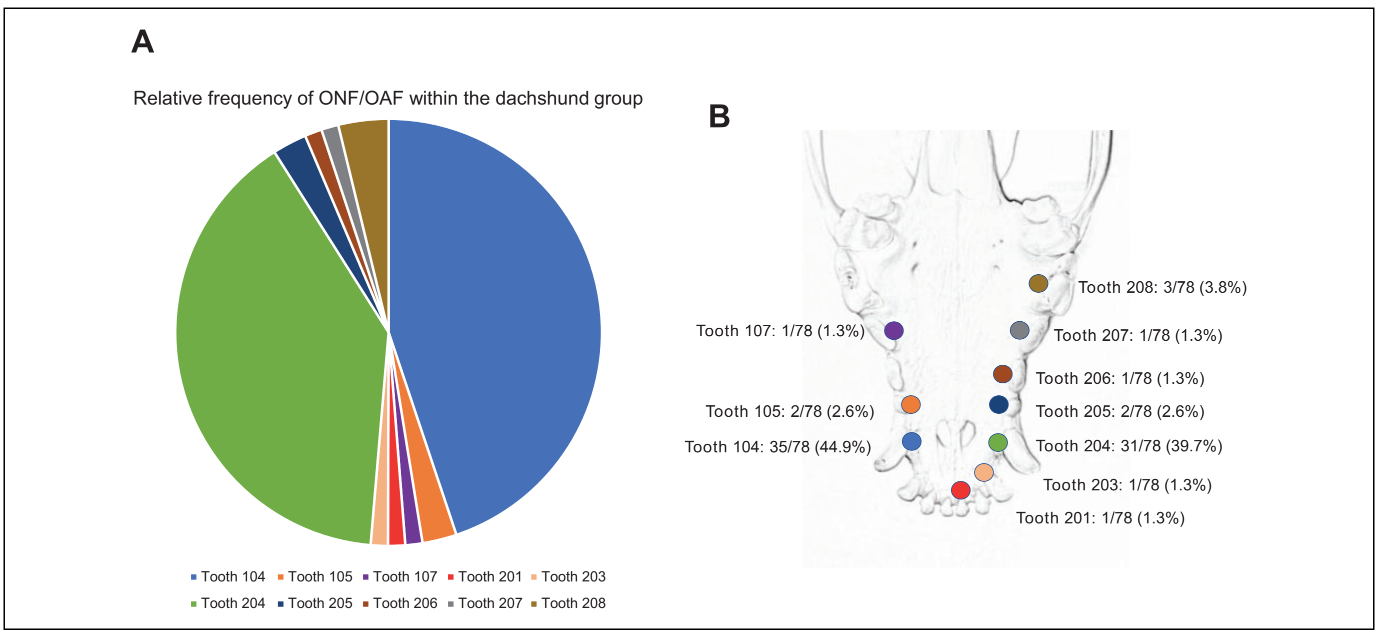

Figure 6. The relative frequency of ONF/OAF within the dachshund group (A and B). Note: Teeth not represented were not associated with ONF/OAF within the dachshund group. ONF/OAF indicates oronasal and oroantral fistula.

periodontal pockets are probed on the palatal aspect of the maxillary dentition and can be confirmed by the presence of ipsilateral nasal hemorrhage.[2] Subsequent to surgical extractions, the alveolus is explored with a periodontal probe to evaluate palatal alveolar bone integrity; an unimpeded penetration of a probe in a palatal direction through a nasoalveolar defect confirms the presence of an ONF/OAF.

Apical periodontitis secondary to endodontic disease can compromise the alveolar bone causing a nasoalveolar defect, resulting in inflammation and infection of nasal tissues.[25] Intraoral radiographs can identify a radiographic lesion of endodontic origin, such as a periapical lucency, but they cannot accurately diagnose a nasoalveolar defect.[2,26] The nasoalveolar defect is diagnosed by evaluation of the alveolus following extraction of the tooth or with cross-sectional imaging such as computed tomography.[25] Although they are clinically relevant, a nasoalveolar defect secondary to endodontic infection is not an ONF/OAF unless it is continuous with a periodontal defect.

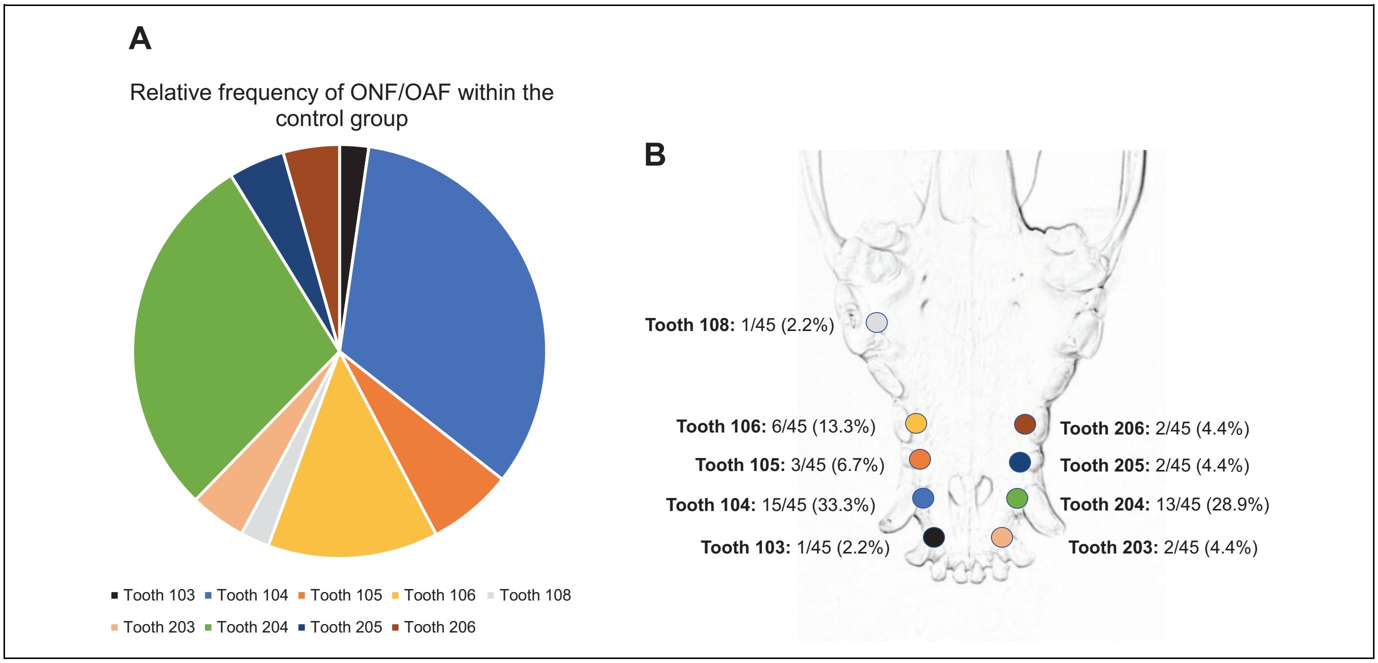

Figure 7. The relative frequency of ONF/OAF within the control group (A and B). Note: Teeth not represented were not associated with ONF/OAF within the control group. ONF/OAF indicates oronasal and oroantral fistula.

A persistent ONF/OAF is a common postoperative complication of surgical extraction. The repair of ONF/OAFs requires strict adherence to oral surgical principles to reduce the risk of complications and recurrence. Pressure changes associated with respirations and manipulations from mastication and deglutition movements constantly challenge the ONF/OAF repair.[23,27,28] Treatment of an ONF/OAF involves the extraction of the associated tooth.[2] Most primary repairs of ONF/OAF associated with the dental arch are successfully repaired with a single-layer mucogingival flap.[1,4,6] Surgical techniques commonly reserved for the treatment of larger or recurrent ONF/OAF of the dental arch include a double-layer flap technique and a free auricular cartilage autograft.[4,8,27,29,30] Several keys to successful surgical repair of ONF/OAFs includes using the technique that is most likely to achieve success; cover the defect without tension; appose clean, healthy, de-epithelialized margins of connective tissue; 2-layer closure when possible; suture line over supportive bony tissue; ensure appropriate vascular supply; and avoid electrosurgery.[23,27,31]

This study confirmed the authors' hypothesis that within the population studied, the dachshund group would have a significantly higher prevalence of ONF/OAFs than the control group comprised of small breed dogs of similar age, weight and sex ($P < .0001$). The odds ratio indicates that dachshunds were 3.3 times more likely to have an ONF/OAF than individuals within the control group (95% confidence interval). It was shown that if one ONF/OAF was present, both the dachshund and control groups had a high frequency of having 2 or more ONF/OAFs (62.8% and 55.5%, respectively).

The exact pathophysiologic mechanism explaining why dachshunds are predisposed to ONF/OAFs is not clear. It is recognized in both human and veterinary dentistry that thinner periodontal tissues may be a contributing factor for the development of periodontal disease.[32-34] Harvey et al identified that there was a relationship between the severity of periodontal disease (gingival inflammation, furcation exposure, mobility, and loss of attachment) and smaller body weight in a large, multicenter study.[35] One study demonstrated that toy breed dogs showed significantly thinner attached gingiva and alveolar bone compared to small- and medium-sized breed dogs which corroborates with the high prevalence of periodontal disease in small breed dogs.[33] Although speculative, the palatal alveolar bone separating the maxillary dentition and the nasal cavity may be thinner in dachshunds compared to small breed dogs of similar age, weight and sex. An anatomical cross-sectional imaging study comparing palatal alveolar bone thickness between various dog breeds with a diversity of skull morphologies could confirm this suspicion. In addition to possible anatomical variation, the dachshund breed may be predisposed to periodontal disease due to factors such as rate of plaque deposition, microflora composition, local factors, systemic factors, immune competence, and the host's genetics.[9,20] It is possible that a combination of the speculative factors contributes to the increased risk of ONF/OAF formation in dachshunds.

Based on the population studied, male dachshunds were significantly more likely to have ONF/OAFs than male controls ($P < .0001$). There was a trend that suggested female dachshunds were more likely to have an ONF/OAF than female controls ($P = .068$), though it was not statistically significant. It is suspected that these results reflect the disparity of prevalence of ONF/OAFs within the study groups irrespective of gender and does not suggest increased risk of ONF/OAF based on sex.

In addition to confirming reports that dachshunds are predisposed to ONF/OAFs, the intent of this study was to increase veterinary professional's awareness of this common cause of morbidity in small breed dogs, particularly dachshunds.[2-4,7-9] This study can be referenced by veterinarians during client communication regarding the importance of preventative oral care. As well, veterinarians can consider these evidence-based clinical findings when prescribing a preventative oral care program including both regularly scheduled professional prophylaxis and home care.

A home care program consisting of diligent daily tooth brushing that complements regularly scheduled professional prophylaxis impedes plaque and calculus accumulation, ultimately reducing the development of periodontal disease and potentially ONF/OAF formation.[36-38] The Veterinary Oral Health Council has published recommendations for daily tooth brushing on all surfaces of the dentition, which includes the palatal/lingual surfaces. Considering the high relative frequency of ONFs associated with the maxillary canines within this study, it is critical to emphasize to clients the importance of brushing the palatal surface of the maxillary canines of small breed dogs, particularly dachshunds.[39] Due to the retrospective nature of the data collection, neither current home care regimens nor the history of professional prophylaxis were queried in a standardized manner and therefore were not evaluated.

The importance of regularly scheduled professional prophylaxis to maintain a healthy periodontium is a fundamental component of maintaining oral health. This provides both an evaluative and therapeutic opportunity for the attending veterinarian. Specifically, a thorough oral evaluation including periodontal probing and intraoral radiographs allows the veterinarian to evaluate the soft tissues, dental tissues, periodontal structures, and endodontic structures of the oral cavity. If a periodontal pocket is increasing in depth compared to conventional norms or previous measurements, strategic intervention can be performed to impede the progression of periodontal disease and its sequela, such as subsequent ONF/OAF formation or tooth loss. Supra- and subgingival scaling followed by polishing removes plaque and calculus, which is an integral component of maintaining periodontal health.[40] This provides the owner with plaque-free dentition to institute home care with the goal of reducing the deposition of plaque between professional prophylaxis treatments. For periodontal pockets <5 mm, treatment typically includes closed root planing and subgingival curettage +/− perioceutic antibiotic administration.[40-42] Periodontal pockets >5 mm require more advanced periodontal surgeries: open root planing and subgingival curettage; crown lengthening procedures +/− osseous recontouring; osseous additive periodontal surgery, including grafts (autograft, allograft, xenograft, and alloplastic grafts); or guided tissue regeneration using a periodontal barrier membrane (resorbable, nonresorbable, bioabsorbable, nonbioabsorbable, synthetic, natural, and biodegradable) +/− grafting material.[40,43]

There are several limitations of this study. First, by the nature of being a retrospective study, there are limitations in that it utilized information that was collected without consideration of the study design, thus, some data points were not collected in a standardized format. For example, there were several patients with adjacent teeth noted to have ONF/OAFs. It was not specifically noted in the dental chart whether these adjacent ONF/OAFs were isolated or continuous with one another. For this study, each ONF/OAF was recorded as an individual defect. Also, the dachshund group was not separated into subgroups of miniature dachshunds, long-haired dachshunds, and standard dachshunds for statistical evaluation due to potentially inconsistent patient breed recording in the practice database (no other phenotypic variations were noted in the practice database). Second, the patients that were included in the study were from the database of a veterinary dental and oral surgery specialty referral practice, which likely manages a higher percentage of advanced or complicated cases than a primary care facility. Therefore, it is possible that the prevalence of ONF/OAF within this study is not representative of a general population of dachshunds and small breed dogs.

In conclusion, this study confirmed and quantified previous reports that dachshunds are predisposed to ONF/OAFs.[2-4,7-9] When compared with a control group, dachshunds were significantly more likely to have an ONF/OAF ($P < .0001$). The odds ratio indicates that dachshunds were 3.3 times more likely to have an ONF/OAF than individuals within the control group (95% confidence interval). Veterinary professionals are responsible for effectively communicating the importance of maintaining oral health in veterinary patients. The evidence-based findings found within this study can be referenced when prescribing home care strategies and regular professional prophylaxis for their patients. Veterinarians must have a heightened awareness of ONF/OAFs within small breed dogs, particularly dachshunds, and focus efforts on both preventative and therapeutic interventions early in the course of disease.

Declaration of Conflicting Interests

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Materials

a. 12, Single End Periodontal probe: 3, 6, 9, 12, Patterson Dental Supply, St. Paul, Minnesota.
b. Stata Statistical Software: Release 13; StataCorp LLC, College Station, Texas.

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