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Appearance of nasopalatine duct cysts on dental magnetic resonance imaging using a mandibular coil: Two case reports with a literature review

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ABSTRACT

Nasopalatine duct cysts (NPDCs), the most common non-odontogenic cysts of maxilla, are often incidental findings on diagnostic imaging. When symptomatic, they usually present as a painless swelling with possible fistula. Conventional radiography shows a round-to-ovoid or heart-shaped radiolucency between the roots of central maxillary incisors. While the radiographic features of NPDCs in X-ray-based modalities have been well described, their magnetic resonance imaging (MRI) features have rarely been reported. Developments in dental MRI in recent years and the introduction of various dental MRI protocols now allow a wide range of applications in dental medicine. MRI is becoming an important tool for the detection and diagnosis of incidental or non-incidental dentomaxillofacial cysts. This report presented and discussed the characteristics of 2 NPDC cases visualized on MRI using both conventional and newly implemented specific dental MRI protocols with a novel 15-channel mandibular coil, demonstrating the use of these protocols for radiation-free maxillofacial diagnoses. ***(Imaging Sci Dent 2023; 53: 161-8)***

KEY WORDS: Cysts; Magnetic Resonance Imaging; Dentistry; Surgery; Oral; Oral Surgical Procedures

Introduction

Nasopalatine duct cysts (NPDCs), the most common non-odontogenic cysts of the maxilla, develop from embryologic epithelial remnants of the nasopalatine duct, possibly due to cell stimulation by infection, local trauma, or mucosal retention, and are estimated to occur in about 1% of the population.[1,2] Due to their location, NPDCs are also commonly termed incisive canal cysts. NPDCs, which are usually incidental findings on diagnostic imaging, account for a significant portion of all jaw cysts. When symptomatic, typically because of NPDC infection, they present as a painless or painful swelling with a possible fistula either to the oral or to the nasal cavity. Generally, the maxillary anterior teeth are vital and are not displaced by the space-occupying lesion.[2,3]

Occlusal radiography displays a round-to-ovoid or heart-shaped radiolucency near the roots of the central maxillary incisors. The characteristic heart shape results from superimposition effects of the anterior nasal spine or septum.[4] Although these conventional radiographic features are suggestive of NPDC, the diagnosis must not be made solely on planar X-rays. Benign and malignant lesions may show overlapping disease patterns; therefore, conditions such as apical periodontitis, odontogenic keratocysts, or even chondrosarcoma must also be considered in the differential diagnosis.[5,6] The definitive diagnosis in symptomatic cases currently often requires a histopathological examination,[4] for which enucleation of the cyst (cystectomy) is required.

To perform an accurate preoperative radiologic evaluation before cystectomy, 3-dimensional imaging using cone-beam computed tomography (CBCT) or computed tomography (CT) is often indicated, given the need for

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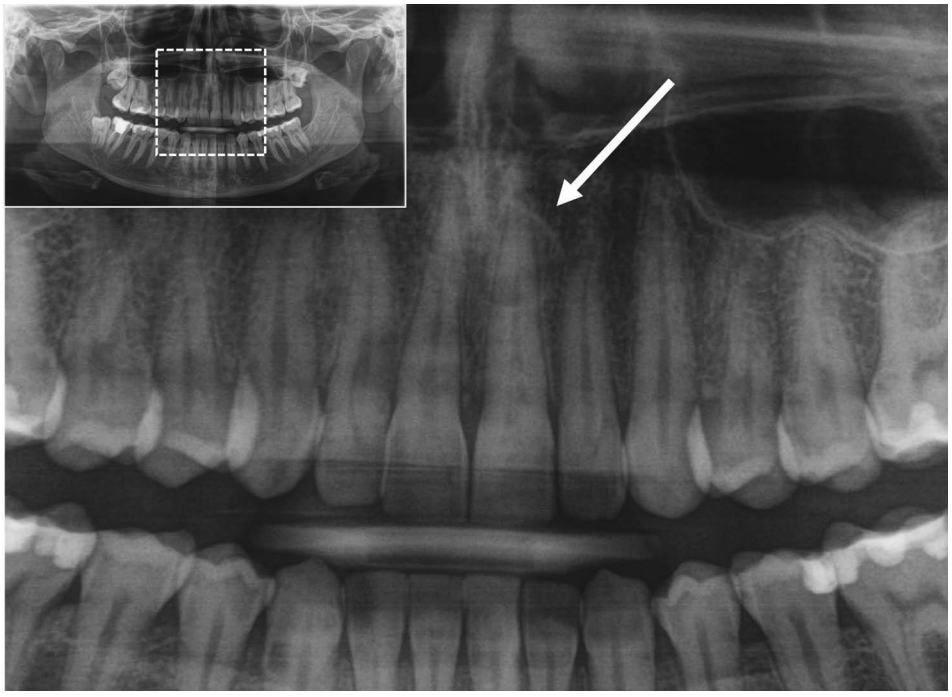

Fig. 1. Case 1. A cropped panoramic radiograph of a 29-year-old female patient shows a well-demarcated, round, space-occupying lesion, eventually diagnosed as a nasopalatine duct cyst, between the roots of the maxillary central incisors. The arrow points to the nasopalatine duct cyst.

information about the precise localization and extension of lesions and the evaluation of possible displacement or even infiltration of adjacent structures. In comparison to CT, CBCT has markedly lower radiation doses and is recognized as the diagnostic gold standard in the dentomaxillofacial region for osseous-tissue imaging, despite its deficiencies in soft-tissue contrast.[7] Magnetic resonance imaging (MRI), as a radiation-free modality, allows the fast, reliable, and precise imaging of hard and soft tissues. In addition to the radiographic features of conventional X-ray-based imaging modalities, dental MRI, with its excellent soft tissue contrast, offers the major advantage of visualizing complex soft tissue pathologies (e.g., nerves and blood vessels) in the oral cavity with a high signal-to-noise ratio.[8] In this regard, several MRI protocols modified for the oral cavity using specific mandibular coils have allowed better visualization of the relative location of space-occupying lesions.[9] However, the MRI features of NPDCs have rarely been reported. With the ongoing implementation of dental MRI protocols in everyday clinical care, the diagnostic features of NPDCs need to be described, and clinicians should be familiar with these features to improve case-specific patient management.

Therefore, we present and discuss the typical characteristics of 2 NPDC cases in MRI using conventional and newly implemented dental MRI-specific protocols using a novel 15-channel mandibular coil to provide further insights into the benefits of this technique for radiologic diagnosis.

Case Reports

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent for publication was obtained from all participating patients involved in the study to publish research findings.

Case 1

In a 29-year-old female patient referred to our department for mandibular third molar surgery, an NPDC located between the central maxillary incisors was incidentally detected on panoramic radiography (Fig. 1). An intraoral examination revealed normal-colored mucosa with moderate, non-tender swelling that the patient was not previously aware of. The patient's general medical and dental history was unremarkable, and a clinical examination revealed vital teeth without any pathology.

A panoramic radiograph showed a 2-dimensional visualization of a well-demarcated round radiolucency between the roots of the maxillary central incisors, with an extension of 5.5 mm × 6 mm. CBCT, which was routinely performed for surgical planning of third molar extraction, revealed a well-demarcated, expansive, round, homogeneous, hypodense space-occupying lesion in the anterior

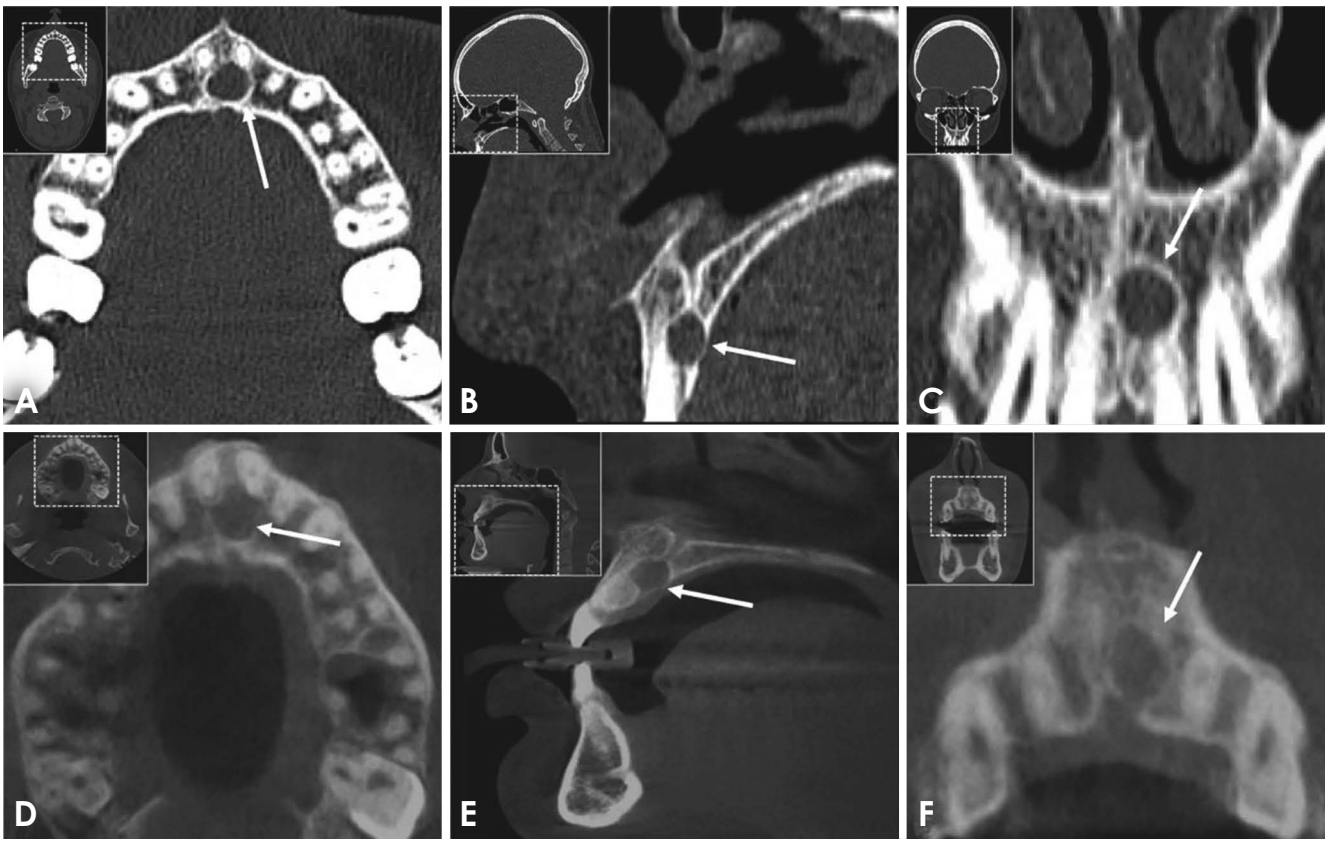

Fig. 2. In a 29-year-old female patient, computed tomography (A-C) and cone-beam computed tomography (D-F) reveal a well-demarcated, expansive, round, homogeneous, hypodense space-occupying lesion (nasopalatine duct cyst) in the anterior midline of the palate between and posterior to the right and left central incisors.

midline of the palate between and posterior to teeth 11 and 21 with a maximum dimension of 7 mm × 6.6 mm (axial), 5.9 mm × 6.3 mm (coronal), and 6.4 mm × 5.9 mm (sagittal). A CT scan performed a year earlier for medical reasons unrelated to this issue retrospectively revealed the same finding of a lesion consistent with an NPDC, with no other pathologic findings (Fig. 2).

A dental MRI examination was performed on a 3-Tesla MRI scanner (Skyra, release VE11e, Siemens Healthineers, Erlangen, Germany) using a 15-channel mandibular coil (NORAS MRI products, Hoechberg, Germany). The MRI protocol for image acquisition included T2-weighted 3D short-tau inversion recovery (STIR), T2-weighted (w) spectrally attenuated inversion recovery (SPAIR), T2w double-echo steady-state (DESS), T1w coronal DIXON-VIBE (volumetric interpolated breath-hold examination) (in-phase [water + fat], out-of-phase [water − fat], water only [in-phase + opposed phase], and fat only [in-phase − opposed phase] images), and ultrashort echo time (UTE) sequences. On T2w imaging in DESS (Figs. 3A-C), STIR (Figs. 3D-F) and SPAIR (Figs. 3G-I) sequences, a well-demarcated homogeneous high-signal-intensity lesion was present between and posterior to the maxillary central incisors, without infiltrating adjacent anatomical structures. In the T1w DIXON-VIBE in-phase sequence (Figs. 4A-C), the lesion was homogeneously isointense or slightly hypointense relative to muscle, whereas in the opposed phase (Fig. 4D), it was isointense relative to muscle; in the fat-only phase, a loss of signal intensity was observed, while in the water-only sequence, it was isointense to muscle (Figs. 4E and F). Thus, the radiologic findings ruled out other involvement of space-occupying pathologies in the head and neck region and yielded the accurate localization and dimensions of the suspected NPDC.

Case 2

A 25-year-old male patient presented to our department for mild swelling and pain in the midline of the hard palate. Conventional X-ray-based imaging revealed a round-to-ovoid radiolucent lesion between the central incisors (Fig. 5), which in the context of the clinical findings,

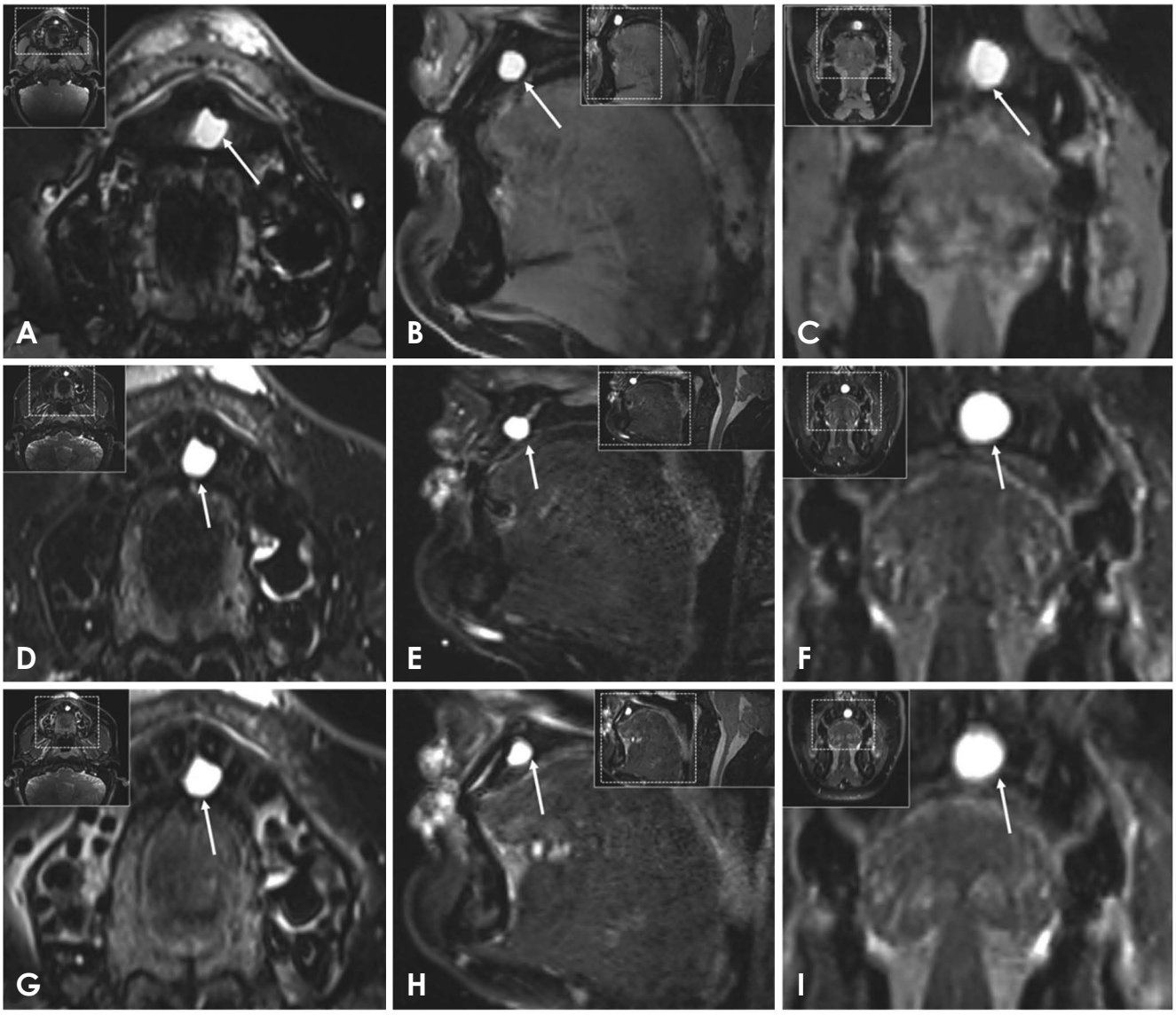

Fig. 3. Magnetic resonance imaging with the T2-weighted DESS (A-C), STIR (D-F), and SPAIR (G-I) sequences reveal a well-demarcated homogeneous high-signal-intensity lesion (nasopalatine duct cyst) between and posterior to the right and left central incisors, without infiltration of adjacent anatomical structures.

raised the suspicion of an NPDC. Considering his young age and intending to minimize or avoid repeated radiation exposure, we suggested the possible use of a dental MRI instead of radiographic CBCT. Hence, with the patient's consent and request for radiation-free dental MRI that could improve diagnosis and treatment, MRI with 3D DESS, 3D STIR, 3D SPAIR, T1w coronal star VIBE, and UTE sequences was acquired with the above-mentioned dental MRI coil. The lesion showed on T2w (DESS, STIR, and SPAIR) a well-defined homogeneous hyperintensity, measuring 4.2 mm × 4.5 mm (axial), 5.0 mm × 4.9 mm (coronal), and 6.1 mm × 3.2 mm (sagittal), was observed, without infiltration or displacement adjacent anatomical structures. In contrast to the first case, the T1w star VIBE sequence revealed a homogeneous hyperintense lesion relative to muscle with a clear margin. A UTE sequence, specifically modified for dental MRI, showed a mildly hyperintense, well-defined lesion in relation to the muscle (Fig. 6).

Discussion

NPDCs are often discovered incidentally on panoramic radiographs or CBCT, presenting as a unilateral or central solitary, well-defined, round to heart-shaped radiolucency in the anterior maxillary median plane of the

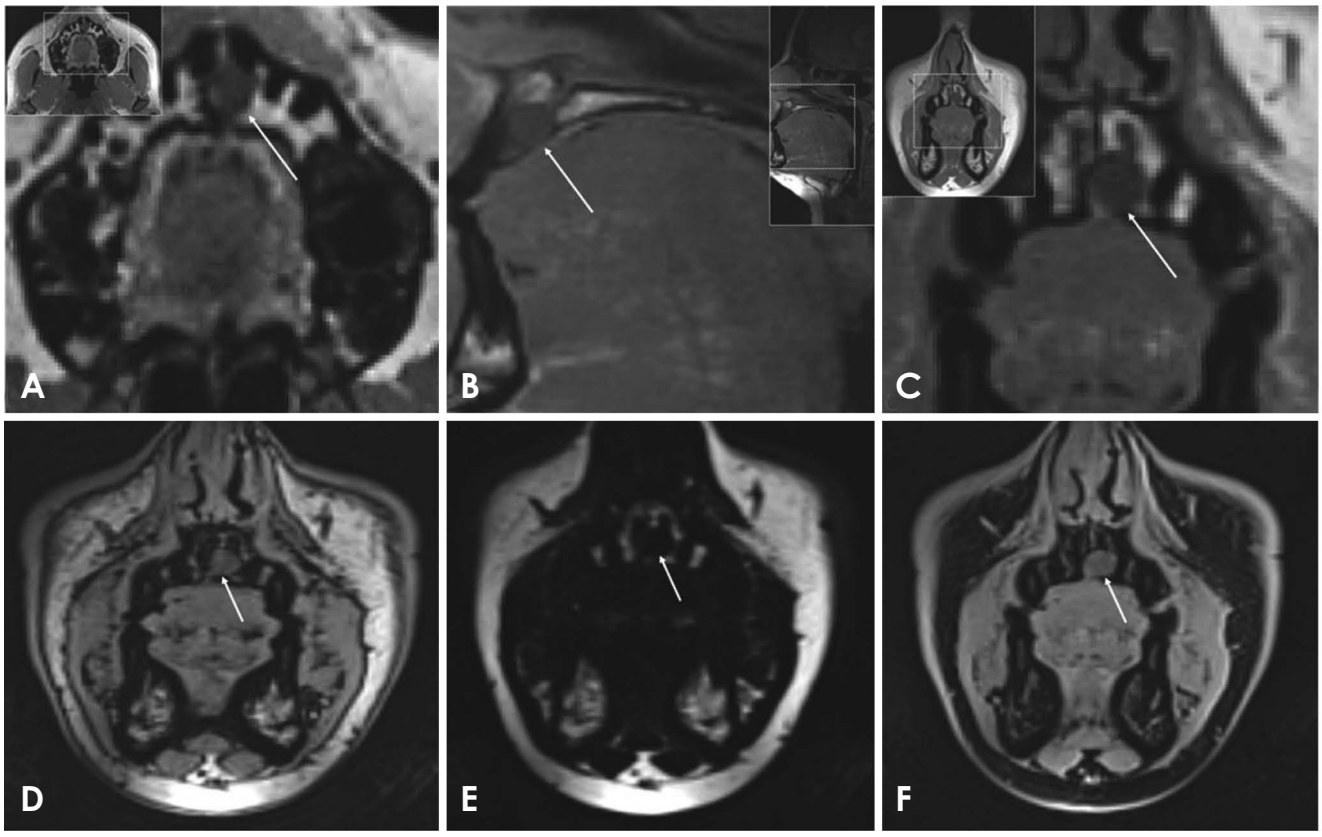

Fig. 4. Magnetic resonance imaging (MRI) of a female patient using a T1-weighted DIXON-VIBE protocol. A-C. In an in-phase (water + fat) sequence, the image shows a homogeneous isointense to slightly hypointense lesion (nasopalatine duct cyst) relative to muscle. D. In the opposed phase (water − fat), it is isointense relative to muscle. E. In the fat-only phase (in-phase − opposed phase) a loss of signal intensity is observed. F. In the water-only (in-phase + opposed phase) sequence, it is isointense to the muscle.

Fig. 5. Case 2. Panoramic radiograph of a 25-year-old male patient reveals a round-to-ovoid, radiolucent space-occupying lesion between the roots of the maxillary central incisors. The arrow points to the suspected nasopalatine duct cyst.

hard palate between the roots of the central incisors. Data suggested a predilection for men, with an average age at diagnosis of about 40 years, although NPDCs could occur at any age.[2,3,10] In asymptomatic patients, this is mostly explained by the increasing frequency of routine X-ray diagnostics preceding dental treatment. The treatment of choice for symptomatic NPDCs is radical surgical excision followed by clinical and radiologic follow-up. This is necessary because the diagnosis cannot be made based on an X-ray examination alone and because X-ray examinations do not allow proper visualization of bone and soft tissue invasion.

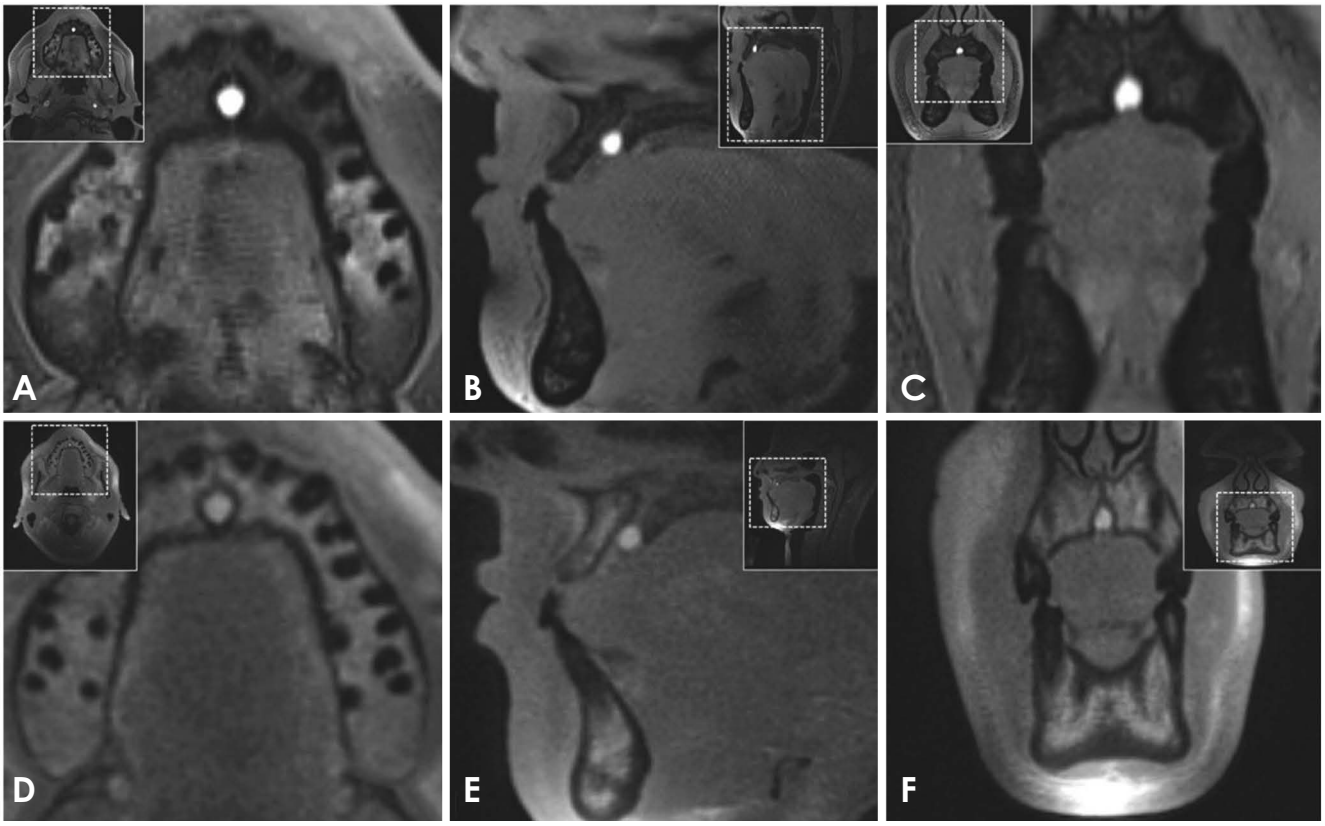

Fig. 6. Case 2. A-C. The T1-weighted star VIBE magnetic resonance imaging (MRI) sequence of a 25-year-old male patient revealed a homogeneous well-defined hyperintense lesion (nasopalatine duct cyst) relative to muscle. D-E. A UTE sequence, specifically modified for dental MRI, showed a mildly hyperintense, well-defined lesion in relation to the muscle.

Occlusal radiography, panoramic radiography, CT, or CBCT with varying radiation exposure are frequently used for initial and postoperative radiologic assessments in clinical practice. They provide excellent visualization of bony structures and pathology; however, repeated exposure to X-rays during dental X-ray examinations has been associated with an increased lifetime risk of radiation-induced cancer, including thyroid cancer, especially in young adolescents.[11] The radiographic appearance of NPDCs on conventional radiography is well described in the literature. Accurate information regarding entities considered in the differential diagnosis, as well as the exact localization, extension and relationship to adjacent anatomical structures, is crucial for the surgeon for preoperative surgical planning.

In the cases presented herein, dental MRI was performed with a novel mandibular coil to produce high-resolution and high-contrast imaging of the oral cavity and to avoid repetitive radiation exposure to patients.[9] There have been few reports documenting the MRI appearance of NPDCs with conventional MRI protocols.[12-14] However, recently implemented promising indication-specific MRI protocols allow the simultaneous visualization of hard and soft tissues, with better detection of the smallest soft tissue tumors due to excellent soft tissue contrast.[9,15] The cases documented in the literature showed homogeneous, well-demarcated lesions with high signal intensity on T1w and T2w imaging.[12,13] In addition, there have been reports of cystic lesions in the oral and maxillofacial region with homogeneous intermediate signal intensity on T1w imaging and hyperintense signal intensity on T2w imaging.[14] The results of this study confirm these findings; however, 1 case showed an isointense lesion relative to muscle in T1w imaging, which may be related to the composition of the cyst. MRI features on the palate in other benign and malignant diseases usually have heterogeneous signal intensity and do not show the same high signal intensity as fluids in T2w imaging because they are not composed of cyst fluid. Hence, the diagnosis of NPDCs in the cases presented herein was possible without intravenous contrast administration, confirming the results of previous studies.[13] The hyperintensity of NPDCs

on T1w imaging can be explained by the composition of cysts, as they contain blood cells and proteins and are viscous.[16] Therefore, the viscous cystic fluid is characteristic of this hyperintense signal on T1w imaging; however, the concentration of keratin or protein could be the reason for discrepancies.[17] However, if distinguishable, the nasopalatine canal is slightly hypointense compared with the NPDC on T1w and T2w imaging. The T1w DIXON-VIBE protocol could provide various information due to the acquired in-phase and out-of-phase images and by generating water-only and fat-only images. T2w imaging using different MRI protocols showed no significant differences in the cases described in this report. Among the newly developed MRI techniques, UTE has emerged as a technique that can directly visualize bone and dental tissue. It provides reliable qualitative and quantitative measurements and information on the exact extent and localization of NPDCs in relation to adjacent osseous anatomical structures.[18] From today's perspective, there are still some disadvantages to the use of dental MRI as an initial diagnostic tool for NPDCs, namely the higher cost, lower global availability, motion artifacts, and artifacts caused by dental restorations.[19,20] Nonetheless, with its improved cost-effectiveness and considering the improved risk-benefit ratio, it has tremendous potential to be further implemented in clinical routines.

In conclusion, a multimodal diagnostic approach that includes clinical, radiologic, and, most importantly, histopathologic evaluations is critical for making an accurate diagnosis in symptomatic or challenging cases. From a radiologic perspective, different imaging modalities can be used to diagnose and depict the extent of NPDCs. Dental MRI allows radiation-free and accurate depictions of NPDCs without diagnostic limitations compared to X-ray-based imaging modalities. Furthermore, this report confirms the previously described appearance of NPDCs in conventional MRI protocols and provides a further understanding of their radiologic characteristics in recently implemented dental MRI-specific protocols using a mandibular coil, which provides superior high-resolution visualization of smaller lesions. In addition, dental MRI may also represent a first step toward a paradigm shift in treatment strategies, especially in younger patients, by enabling long-term radiation-free radiologic follow-up while avoiding the immediate need for surgical intervention. Thus, this additional information represents another step toward personalized medicine and can be used for the perioperative imaging of soft tissue pathologies with an improved risk-benefit ratio to minimize risks and ineffectiveness in preoperative decision-making by considering patient-specific factors.

Conflicts of Interest: None

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