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ANATOMIC VARIATIONS

Rare anatomical variation related to the nasopalatine canal

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Abstract The nasopalatine canal is a relatively long narrow structure located in the midline of the maxilla that contains the nasopalatine nerve and terminal branch of the descending palatine artery. Anatomical variations related to this structure have been reported. This article aimed to report a case of a complete additional nasopalatine canal on a 53-year-old female patient who underwent an examination by cone beam computed tomography. On sagittal slices, it was possible to observe the presence of an additional canal anterior and superior to the nasopalatine canal, separated by a bony septum. Each canal extended from independent superior openings (located in the nasal cavity) to independent openings located in the remaining alveolar process of the anterior maxilla. Identification of individual anatomical variations, especially involving neurovascular structures, plays an important role in the successful outcomes of surgical procedures involving the anterior maxilla.

Keywords Nasopalatine canal · Incisive canal · Anatomical variation · Maxilla

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Introduction

The nasopalatine canal is a relatively long narrow structure located in the midline of the maxilla that contains the nasopalatine nerve and terminal branch of the descending palatine artery. This bony canal connects the roof of the oral cavity with the floor of the nasal cavity. The inferior part of the nasopalatine canal is a continuation of the funnel-shaped incisive fossa and the incisive foramen, and the superior part is divided into two foramina (the nasopalatine foramen or the foramen of Stensen) by the nasal septum in the nasal floor. In some cases, two additional minor canals can be seen (foramina of Scarpa), which may transmit the nasopalatine nerve [5, 9].

On two-dimensional radiographic exams, the image of the incisive foramen is usually projected between the roots of the central incisors. The foramen varies markedly in shape, size, and sharpness. This may be the result of the projection geometry and the variability in anatomic morphology. The lateral walls of the nasopalatine canal may occasionally be seen as a pair of radiopaque lines extending from the incisive foramen to the nasal floor level [5].

Anatomical variations related to the nasopalatine canal [2, 4, 7] have been reported in the literature. However, the presence of a complete additional nasopalatine canal has never been reported. Accessory foramina and canals may often be neglected in the clinical procedures. It is important

to emphasize that these anatomic variations can only be preoperatively detected on imaging, and their early detection can have a direct influence on therapeutic success. Therefore, the aim of this article was to describe a rare anatomical variation: the presence of an additional nasopalatine canal.

Case report

A 53-year-old female patient underwent cone beam computed tomography (CBCT) examination (Kodak 9000, Carestream Health, Rochester, New York, USA) to assess bone quality and quantity for dental implants placement planning in the anterior maxilla region. Medical history was irrelevant, the patient was asymptomatic, overlying mucosa in the edentulous anterior maxilla had normal appearance, and no anesthetic problems related to previous extractions of upper central and lateral incisors were reported. On CBCT sagittal slices (Fig. 1) and cross-sections perpendicular to the additional canal (Fig. 2), it was possible to observe the presence of an additional canal anterior and superior to the nasopalatine canal, separated by a bony septum, each extending from independent superior openings (located in the nasal cavity), to independent inferior and anterior openings located in the remaining alveolar process of the anterior maxilla. The diameter of the additional canal ranged between 1.2 and 2.0 mm. On cross-sections perpendicular to the additional canal it was possible to observe the elliptical narrowed shape of the additional canal (Fig. 2). During the surgical procedure for implant placement in the anterior maxilla, the anatomical structures were carefully preserved. After 30 days, the patient had no postoperative complications.

Discussion

Due the close anatomical relationship between the nasopalatine canal and the roots of the central maxillary incisors, a careful radiological analysis is necessary when insertion of a dental implant is planned in that region. Using CBCT images to achieve a safe surgical procedure, it is possible to identify the course of nerves and vessels in the anterior maxilla, as well as their possible anatomical variations [4, 8].

According to Song et al. [9], the inferior opening of the nasopalatine canal (incisive foramen) always consists of a single foramen, whilst the superior openings (nasopalatine foramina) consist of two or more foramina. However, the present case showed an unusual anatomical variation: the presence of two virtually parallel independent nasopalatine canals, with distinctive foramina in the nasal cavity (i.e., superior–posterior openings) and in the remaining alveolar process of the anterior maxilla (i.e., anterior–inferior openings).

Bornstein et al. [2] evaluated the morphology of the nasopalatine canal in 106 individuals with partially edentulous anterior maxilla. Single nasopalatine canals were observed in most cases, followed by "Y" shaped types, and two separated parallel canals. The separated canals observed in our case are also parallel, but differ from those described by Bornstein et al. [2] because they are not contralateral, but are rather located in the midline with the additional canal running superiorly, and slightly anteriorly, from the nasopalatine canal.

Oliveira-Santos et al. [4] reported cases of additional foramina adjacent to the incisive foramen. However, in those cases, the canals associated with the additional foramina were not independent, i.e., joined the nasopalatine canal superiorly.

The nasopalatine canal may present variations in its shape as widened or spindle-shaped, very large, narrowed and in some case a cystic sinus appearance may be found [9]. In the present case, the shape of the additional nasopalatine canal observed on CBCT images could be classified as narrow shaped. Inflammatory sinus tract was ruled out because pain, swelling, and fistula were not present.

CBCT is an important tool for the evaluation of maxillary anatomical variations, especially the nasopalatine canal [2, 4, 7]. This imaging technology has been increasingly used in several areas of dental medicine,

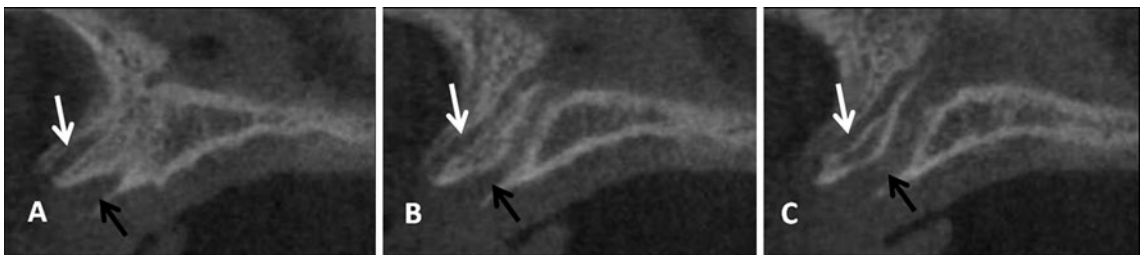

Fig. 1 CBCT sagittal slices showing the presence of an independent additional canal (*white arrows*) located anterior and superior to the nasopalatine canal (*black arrows*)

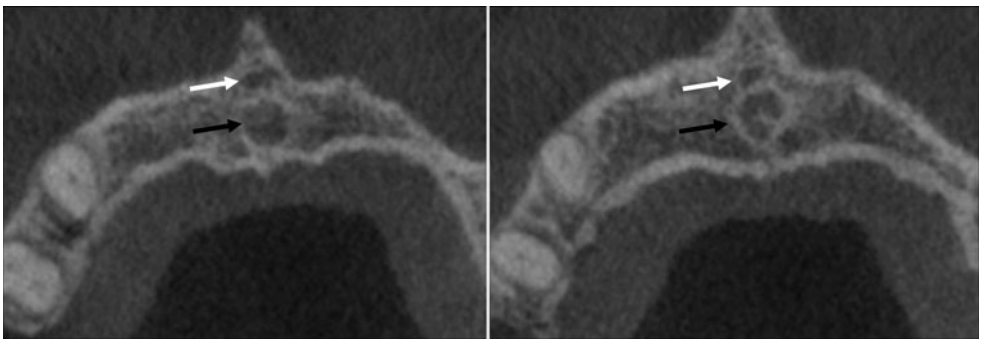

Fig. 2 CBCT cross-sections perpendicular to the additional canal showing the narrowed elliptical shape of the additional canal (*white arrows*), anterior to the nasopalatine canal (*black arrows*)

because it allows three-dimensional evaluation of maxillofacial structures, offering clear structural images with high contrast. Although exposure dose remains a controversial concern with 3D imaging, it has been shown that proper selection of exposure parameters and field size may produce relatively low-dose CBCT exams, especially if compared to multislice computed tomography (MSCT). Other advantages of CBCT over MSCT include lower cost and fewer artifacts [6].

Identification of the individual anatomical variations, especially involving neurovascular structures, may play an important role in successful outcomes of surgical procedures involving the anterior maxilla. Even though surgical approaches involving either obliteration of the nasopalatine canal [10] or displacement of its neurovascular contents [1] have been proposed for implant placement, their impact on sensory function of the anterior palate is not fully understood [10]. Careful identification of the precise trajectory of the nasopalatine canal during preoperative CBCT evaluation is important because injury to its neurovascular content may have implications on the patient's quality of life, postoperatively. Traumatic or iatrogenic injury to the nasopalatine nerve may result in hypoesthesia, paresthesia, or pain. Hemorrhage may also occur in case of damage to the nasopalatine artery [3].

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References

1. Artzi Z, Nemcovsky CE, Bitlitum I, Segal P (2000) Displacement of the incisive foramen in conjunction with implant placement in the anterior maxilla without jeopardizing vitality of nasopalatine nerve and vessels: a novel surgical approach. Clin Oral Implants Res 11:505–510. doi:10.1034/j.1600-0501.2000.011005505.x
2. Bornstein MM, Balsiger R, Sendi P, von Arx T (2011) Morphology of the nasopalatine canal and dental implant surgery: a radiographic analysis of 100 consecutive patients using limited cone-beam computed tomography. Clin Oral Implants Res 22: 295–301. doi:10.1111/j.1600-0501.2010.02010.x
3. Chandra RK, Rohman GT, Walsh WE (2008) Anterior palate sensory impairment after septal surgery. Am J Rhinol 22:86–88. doi: http://dx.doi.org/10.2500/ajr.2008.22.3114
4. de Oliveira-Santos C, Rubira-Bullen IR, Monteiro SA, León JE, Jacobs R (2012) Neurovascular anatomical variations in the anterior palate observed on CBCT images. Clin Oral Implants Res. doi:10.1111/j.1600-0501.2012.02497.x
5. Jacobs R, Lambrichts I, Liang X, Martens W, Mraiwa N, Adriaensens P, Gelan J (2007) Neurovascularization of the anterior jaw bones revisited using high-resolution magnetic resonance imaging. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 103:683–693. doi:10.1016/j.tripleo.2006.11.014
6. Miracle AC, Mukherji SK (2009) Conebeam CT of the head and neck, part 1: physical principles. AJNR Am J Neuroradiol 30:1088–1095. doi:10.3174/ajnr.A1653
7. Mraiwa N, Jacobs R, Van Cleynenbreugel J, Sanderink G, Schutyser F, Suetens P, van Steenberghe D, Quirynen M (2004) The nasopalatine canal revisited using 2D and 3D CT imaging. Dentomaxillofac Radiol 33:396–402. doi:10.1259/dmfr/53801969
8. Neves FS, Crusoé-Souza M, Franco LC, Caria PH, Bonfim-Almeida P, Crusoé-Rebello I (2012) Canalis sinuosus: a rare anatomical variation. Surg Radiol Anat 34:563–566. doi:10.1007/s00276-011-0907-6
9. Song WC, Jo DI, Lee JY, Kim JN, Hur MS, Hu KS, Kim HJ, Shin C, Koh KS (2009) Microanatomy of the incisive canal using three-dimensional reconstruction of microCT images: an ex vivo study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 108:583–590. doi:10.1016/j.tripleo.2009.06.036
10. Verardi S, Pastagia J (2012) Obliteration of the nasopalatine canal in conjunction with horizontal ridge augmentation. Compend Contin Educ Dent 33:116–120