

## Canalis sinuosus: a rare anatomical variation

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**Abstract** The infraorbital canal issues a small branch on its lateral face close to its midpoint to allow passage of the anterior superior alveolar nerve. This small canal, sometimes called the canalis sinuosus, runs forward and downward to the inferior wall of the orbit, lateral to the infraorbital canal and medially bent to the anterior wall of the maxillary sinus, passing below the infraorbital foramen. Anatomical variations in the maxilla are rarely described in the literature and, in most cases, are related to the nasopalatine canal. This article describes a rare anatomical variation of the presence of a bilateral accessory canal extending from the nasal cavity lateral wall to an accessory

foramen located on the hard palate, adjacent to the maxillary lateral incisor observed in cone beam computed tomography (CBCT) images. This case is an anatomical variation of the anterior superior alveolar nerve (canalis sinuosus). Identification of individual anatomical variations, especially on CBCT, may help the surgeon to avoid injuries to nerves during implant placement.

**Keywords** Anterior superior alveolar nerve · Canalis sinuosus · Anatomical variation · Maxilla

### Introduction

The infraorbital nerve is a branch of the maxillary nerve, which is the second division of the trigeminal nerve. The infraorbital nerve supplies the skin and midface mucosa. When it emerges on the face by the infraorbital foramen, the infraorbital nerve is divided into three alveolar proximal branches (anterior, middle, and posterior superior alveolar nerves) and four distal branches (inferior palpebral, external nasal, internal nasal and superior labial) [1, 4].

The infraorbital canal issues a small branch on its lateral face close to its midpoint to allow passage of the anterior superior alveolar nerve. This small canal, sometimes called the canalis sinuosus, runs forward and downward to the inferior wall of the orbit, lateral to the infraorbital canal and medially bent to the anterior wall of the maxillary sinus, passing below the infraorbital foramen. After reaching the edge of the anterior nasal aperture in front of the anterior end of inferior turbinate, it follows the lower margin of the nasal aperture and opens to the side of the nasal septum in front of the incisive canal [2]. The canalis sinuosus contains the anterior superior alveolar nerve, as well as veins and corresponding arteries [6].

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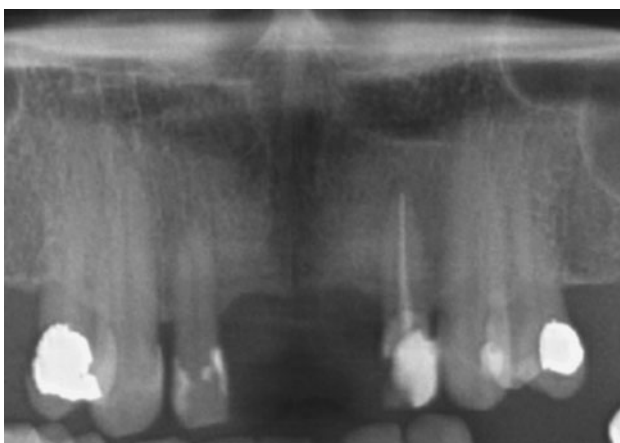
Anatomical variations in the maxilla are rarely described in the literature and, in most cases, are related to the nasopalatine canal [3]. It is important to identify other anatomical variations in the maxilla (e.g. canalis sinuosus). Information about this structure should be considered in cases of implant surgery to avoid damage to neurovascular structures. This article describes a rare anatomical variation: the presence of an accessory and bilateral canal in the anterior maxilla region, using cone beam computed tomography (CBCT) images.

### Case report

A 54-year-old woman attended a private clinic for dental implant placement. Extraoral and intraoral examinations showed no significant issues. On panoramic radiography, a narrow radiolucent area, similar to a canal, was observed adjacent to the radicular apex of the upper right lateral incisor, toward the side wall of the nasal cavity (Fig. 1).

The patient underwent an examination by CBCT (Kodak 9000, Carestream Health, Rochester, NY, USA) to assess the bone quality and quantity for placement of dental implants in the anterior maxilla region. In the sagittal slices (Fig. 2), a bilateral accessory canal was observed, thicker on the right than on the left, extending from the lateral nasal wall to an accessory foramen located on the hard palate, lingually to the maxillary lateral incisor. The accessory canals could be observed in the coronal and axial slices (Fig. 3). The shape and location of the nasopalatine canal appeared normal.

During the surgical procedure for bone graft placement in the anterior maxilla, the periosteum was dissected, and the innervation of the accessory canals could be observed (Fig. 4). The anatomical structures were carefully preserved during surgery. After 30 days, the patient had no postoperative complications.



**Fig. 1** Cropped panoramic radiograph of the case

### Discussion

The presence of accessory foramina and canals is often neglected in clinical procedures. These anatomic variations can only be detected preoperatively on imaging, and their presence can have a direct influence on therapeutic success.

Several surgical procedures are performed in the anterior maxilla and mandible. With the increase in placement of dental implants and bone grafting procedures for oral rehabilitation, increasing numbers of complaints are being reported in the postoperative period [3]. Therefore, it is important to consider the presence of neurovascular bundles of the nasopalatine canal, incisive mandibular canal, superior and inferior genial spinal foramina, due to the risk of neurosensory disturbances and hemorrhage.

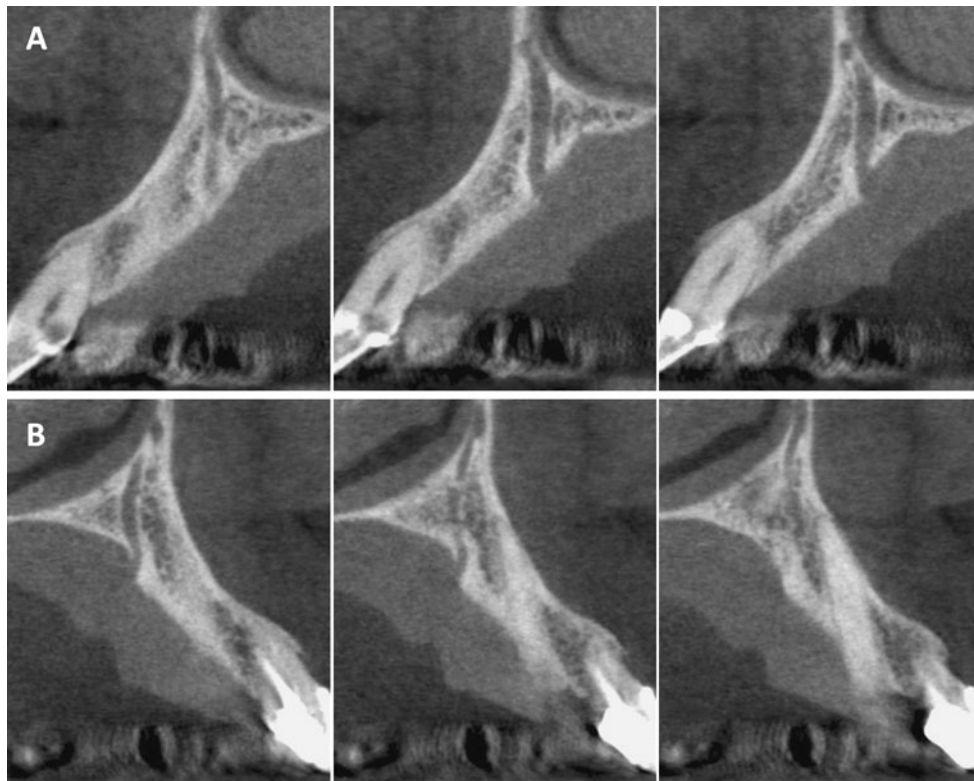
In the present case, we hypothesized the possibility of accessory canals because the nasopalatine canal was in a lateral position for embryonic reasons. However, the anatomical position of the nasopalatine canal was normal in the CBCT images.

Jones [2] described the anterior superior alveolar nerve and vessels leaving the infraorbital nerve behind the infraorbital foramen and running laterally in a 2 mm diameter bony canal. Due to its double curved course, the term *canalis sinuosus* is more appropriate. Shelley et al. [5] observed, in a periapical radiograph of the right maxillary canine, a band with cortical radiolucent borders typical of an accessory canal, and suggested that this anatomical variation could be a *canalis sinuosus*. We believe that the present case is a *canalis sinuosus* based on the CBCT findings.

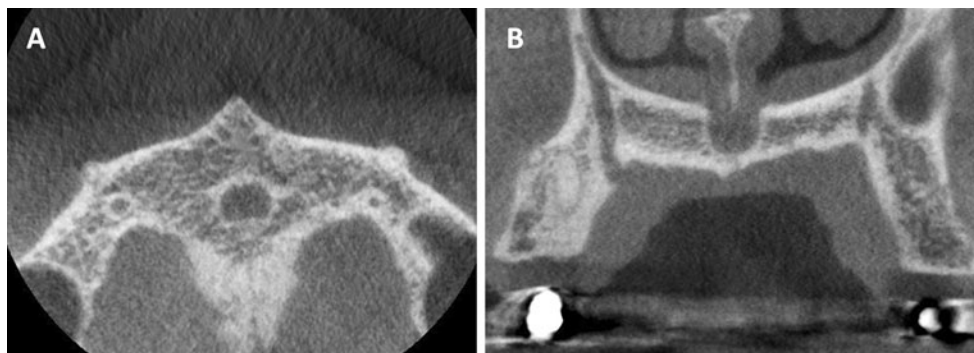
Surgery for placement of dental implants in the anterior maxilla is often difficult to perform due to biomechanics, and the phonetic and aesthetic requirements necessary to find a perfect compromise with the anatomical limitations. The insertion of implants close to the canal can compromise the success of the surgery. Contact with the neurovascular bundle can actually lead to non-integration of the implant or sensory dysfunction. It is essential to obtain as much information as possible, especially on radiographic images, about the anatomic appearance and variations for a safer surgical procedure [3].

Moreover, before surgery in the maxilla and anterior mandible, the surgeon should consider the need to locate the presence of neurovascular bundles. In this case, the anatomical variations were identified on preoperative CBCT images and placement of dental implants was carried out carefully to avoid injury to accessory neurovascular bundles. Hence, at follow-up the patient reported no complications after surgery.

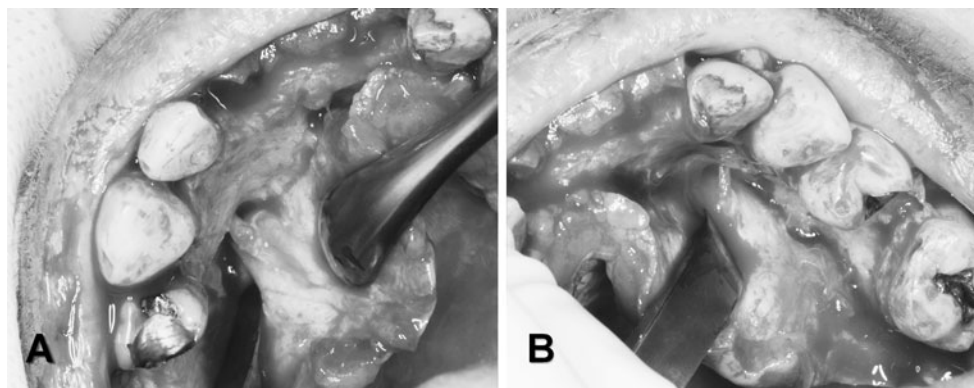
CBCT provides reliable high-resolution images and superior technology compared with its predecessors, and



**Fig. 2** Sagittal CBCT slices showing the presence of the accessory canals on the right (a) and left (b) sides



**Fig. 3** Axial (a) and coronal (b) CBCT slices showing the presence of the accessory canals, completely distinct from the nasopalatine canal



**Fig. 4** Direct intraoperative visualization of the anterior superior alveolar nerves of the accessory canals on the right (a) and left (b) sides

can generate images with a small slice thickness and good visualization of bony structures. We believe it is possible to recognize this anatomical variation on computed images with cone beam technology, especially if a smaller voxel size is used.

In conclusion, this paper reports an anatomical variation of the anterior superior alveolar nerve, also called *canalis sinuosus*. Identification of individual anatomical variations, especially with the CBCT, may help the surgeon to avoid injuries to nerves during implant placement.

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**Conflict of interest** The authors declare that they have no conflict of interest.

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