The sinuous canal's lateroantral course and duplication

Rusu M.C.[1], Jianu A.M.[2], Ilie O.C.[3], Mănoiu V.S.[4]

[1]Division of Anatomy, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania
[2]Department of Anatomy and Embryology, Faculty of Medicine, "Victor Babes" University of Medicine and Pharmacy, Timişoara, Romania
[3]Faculty of Dental Medicine, "Victor Babes" University of Medicine and Pharmacy, Timişoara, Romania
[4]Department of Cellular and Molecular Biology, National Institute of Research and Development for Biological Sciences, Bucharest, Romania

Correspondence to:
Name: Rusu M.C.
Address: "Carol Davila" University of Medicine and Pharmacy, 8 Eroilor Sanitari Blvd., RO-050474, Bucharest, Romania
Phone: +40 723628148
E-mail address: mugurel.rusu@umfcd.ro

Abstract

The canalis sinuosus (CS) branches from the infraorbital canal (IOC) and carries the anterior superior alveolar nerve (ASAN) mainly distributed to the upper frontal teeth. Common descriptions indicate a single CS with an infraorbital initial segment, continuing with a transverse facial course within the anterior antral wall. It is reported here a case which was documented in Cone Beam Computed Tomography in which, on one side, the initial course of the CS was not superior to the antrum, but lateral to it. On the opposite side the CS was duplicated. Such variations of the CS should not be ignored during surgical approaches of the maxillary sinus walls, especially of the canine fossa.

Keywords: maxillary sinus; maxillary nerve; infraorbital nerve; canine fossa; superior alveolar nerve

INTRODUCTION

The canalis sinuosus (CS) of Wood Jones is commonly regarded as branching from the infraorbital canal (IOC) in the roof of the maxillary sinus (MS) (Rusu et al., 2021). Thus, the first segment of the CS is an infraorbital one (Von Arx and Lozanoff, 2016). The following segment of the CS is the transverse facial one coursing through the anterior antral wall beneath the infraorbital foramen (IOF) (Jones, 1939, von Arx and Lozanoff, 2015). The CS carries the anterior superior alveolar nerve (ASAN), branched from the infraorbital nerve (ION), and a branch of the infraorbital artery (Rusu et al., 2021, von Arx and Lozanoff, 2015, Rusu et al., 2017). A rare anatomic possibility of the CS is its course through the MS (Rusu et al., 2021) instead of its common course within the MS roof. When both the IOC and the CS protrude within the MS they form buttresses separated by recesses (Jones, 1939). If referred to the IOC, such recesses are termed infraorbital recesses (Carstocea et al., 2019).

Aim and objectives

The aim of this study is checking the course of the canalis sinuosus (CS) in Cone Beam Computed Tomography.

MATERIAL AND METHODS

The archived cone-beam computed tomography (CBCT) files of a 48-year-old male patient were retrospectively studied. The patient had been scanned for dental medical purpose using an iCat CBCT machine (Imaging Sciences International, Hatfield, PA, USA) (resolution of 0.250, FOV 130^{o}, image matrix size of 640 × 640). The CBCT data were exported as a single uncompressed DICOM file, which was analysed using the Planmeca Romexis Viewer 3.5.0.R software, an approach that has been applied in other studies (Carstocea et al., 2019, Rusu et al., 2020). The anatomical details were evaluated on planar slices as well on three-dimensional volume renderings. The patient had provided written informed consent for all his medical data (including CBCT scans) to be used for research and teaching purposes, provided that the anonymity and confidentiality were maintained.

RESULTS

Morphological features of anterior antral walls were then studied (**fig.1**). On each side the IOC began immediately anterior to the inferior orbital fissure, continuing extremely short infraorbital grooves. Both IOCs opened at the infraorbital foramina (IOF) above the interproximal septum between the respective two upper premolars. On the left side a single CS left the lateral side of the respective IOC and coursed through the lateral wall of the MS (lateroantral course) to continue with the transverse facial segment in the anterior wall of the antrum inferior to the IOF. Two infraorbital recesses of the left MS were formed: the medial one was on the inner side of the IOC and the lateral one was located between the buttress of the IOC and that of the CS. On the right side a duplicate CS was found. The lower component left distally the IOC, had a lateroantral course, and continued in the anterior antral wall. The upper component of that duplicate CS left proximally the IOC, coursed within the antero-lateral antral wall, and continued superiorly to the lower component within the anterior wall of the MS. From medial to lateral three different recesses of the MS were distinguished in the anterior antral wall, a medial infraorbital one, on the medial side of the IOC, and two lateral infraorbital ones, between the IOC and the upper CS and, respectively, between the two components of the CS.

DISCUSSIONS

In the case reported here was found the lateroantral course of the CS. This topographic variant probably resulted from a premature distal origin of the ASAN from the ION. Although rare, even the ION could have a lateroantral, and not infraorbital course (Rusu et al., 2015).

There are reports that associate the CS just with the ASAN (Neves et al., 2012). It is however a neurovascular canal (Torres et al., 2015). Therefore, it should not surprise if the neurovascular content courses into separated vascular and neural canals. Moreover, dissections in five cadavers demonstrated that the ASAN continued in the anterior antral walls either as a single trunk (40%), or as two branches (40%), or as three branches (20%) (von Arx and Lozanoff, 2015). Therefore, if the ASAN is branched within the anterior antral wall, distinctive CS could be found. In CBCT just canals are observed, their content being just presumed. Clinicians should be aware that although the ASAN maintains consistent coordinates at specific points along its course through the midface, it could be duplicated, or double, such as in this present report. Such double ASAN trunk with no branches was found in just 10% of maxillae (Robinson and Wormald, 2005).

Intractable posttraumatic nerve deficits secondary to injuries of the ION or ASAN are common in patients with midface fractures (Olenczak et al., 2015). Such fractures determine nerve injury through compression, transection, or avulsion (Olenczak et al., 2015). While lesions of the ION lead to hypoesthesia, hyperesthesia, paraesthesia, and pain of the midface, lesions of the ASAN are discriminated by intractable neuropathic pain localized to the premaxilla (Olenczak et al., 2015). Therefore it is important to clinicians to adequately know the anatomy of the maxilla, as the IOC is not the only canal traversing it.

The transverse facial segment of the CS courses inferiorly to the infraorbital foramen and is commonly joined by the lateral antral canal (LAC). The LAC is a vascular one and contains the lateral or alveolar antral artery (arcade, anastomosis) that starts at the tuberosity of maxilla and anastomoses the superior alveolar arteries, posterior and anterior (Ilie et al., 2015). Therefore, the LAC courses inferiorly to the transverse facial segment of the CS in the canine fossa wall. Both canals should be adequately located preoperatively by CT or CBCT, in order to personalize the surgical procedures involving the canine fossa. Nerve injuries occur in approximately 40% of canine fossa trepanations and there is a considerable loss (10-30%) of dental sensitivity after surgery of the outer antral wall (Heasman, 1984, Murakami et al., 1994). The safest entry point for a canine fossa puncture is the vertical line drawn through the mid-pupillary line bisection point by a horizontal line through the floor of the pyriform aperture (Robinson and Wormald, 2005). However, this safe zone was considered without taking into account the course of the LAC. On other hand, the Caldwell Luc antrostomy could be used for resection of superior alveolar nerves and neurolysis of the ION in cases with refractory facial pain (Musavi et al., 2018).

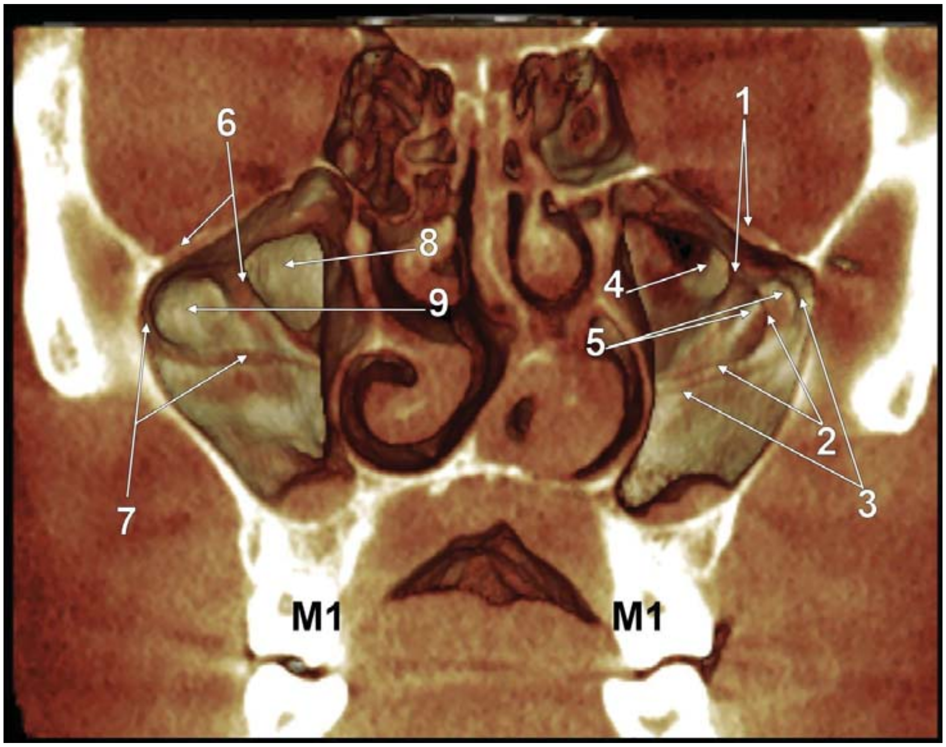

Figure 1. Three-dimensional volume rendering of the anterior antral walls. Right duplicate canalis sinuosus. Endosinus posterior view. 1.right infraorbital canal; 2. upper component of the right canalis sinuosus; 3.lower component of the right canalis sinuosus; 4.medial infraorbital recess; 5.lateral infraorbital recesses; 6.left infraorbital canal; 7.left canalis sinuosus; 8.medial infraorbital recess; 9.lateral infraorbital recess. M1: first maxillary molar

CONCLUSIONS

In conclusion, avoidance of unwanted iatrogenic consequences is possible if the possibilities of variation are well known and documented preoperatively.

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