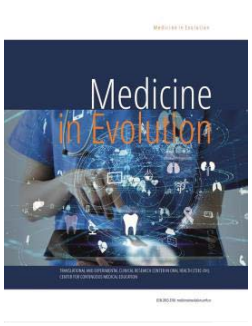
The nasomaxillary or septo-premaxillary crest



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Abstract

The nasopalatine (incisive) canal of maxilla (NPC/IC) is commonly assigned a"Y" shape in coronal plane. The two upper arms of that canal are separated by an osseous piece that was indicated as nasomaxillary crest (NMC) in fetuses and is located on the course of the septo-premaxillary ligament. The NMC, or septo-premaxillary crest (SPMC), was not studied previously in human adults. It was therefore performed a Cone Beam Computed Tomography study on a retrospective lot of forty-one cases, ten males and thirty-one females. On coronal slices were found five types of NMC/SPMC: (a) type I – median, long NMC/SPMC, descending into the NPC (51.22%); (b) type II – inclined, long NMC/SPMC, descending into the NPC (2.44%); (c) type III – median, short NMC/SPMC, above the NPC (21.95%); (d) type IV – median, short NMC/SPMC, absent NPC (4.88%); (e) type V – inclined, short NMC/SPMC, absent NPC (19.51%). Seemingly, the NMC persists in adults as a distinct osseous structure on the course of the septo-premaxillary ligament and determines the variable patterns of the NPC/IC.

Keywords: Hard palate, CBCT, nasopalatine canal, incisive canal, nasal septum

INTRODUCTION

The nasopalatine canal (NPC), or the incisive canal (IC) of maxilla, connects the anterior nasal floor with the anterior hard palate. Different morphologies were assigned to the NPC in the frontal (coronal) plane, a common one being the „Y"-shaped form (Bornstein et al., 2011). In the „Y" shaped NPCs the two superior arms of the canals are separated between by a bony wall different from the nasal septum (NS).

According to Radlanski et al (2004) the NPC/IC attains its typical pattern in the 24th fetal week, consisting of two nasal orifices, a common palatal one, and a"nasomaxillary crest" separating the bilateral neurovascular elements within the canal (Radlanski et al., 2004). Latham (1970) described in embryo that a median tract descends from the NS to the premaxilla on the side of the interpremaxillary suture (Latham, 1970). He termed that structure"septo-premaxillary ligament" (Latham, 1970). That ligament appears as a bundle of fibers arising from the antero-inferior border of the NS and courses to insert on the anterior nasal spine and within the interpremaxillary suture (Latham, 1970). According to Latham (1970), during morphogenesis, the anterior extension of the vomer bone is limited presumably by the septo-premaxillary ligament (Latham, 1970). Therefore, the septo-premaxillary ligament described by Latham (1970) occupies the anatomical site of the nasomaxillary crest of Radlanski (2004). This crest is anterior to, and different from the nasal crest of maxilla that is joined with the vomer bone.

Aim and objectives

This study aims to investigate the morphological possibilities of the nasomaxillary or septo-premaxillary crest (NMC/SPMC) in human adults.

MATERIALS AND METHODS

A retrospective Cone Beam Computed Tomography (CBCT) study of the archived files of 41 adult patients. From the 41 cases, ten (24.39%) were male and 31 (75.61%) were female.

The subjects were scanned with an iCat CBCT machine (Imaging Sciences International [Hatfield, PA, USA]) with the settings: resolution 0.250 mm, FOV 130, and image matrix size 640 × 640 px. The CT data were analysed using the Planmeca Romexis Viewer 3.5.0.R software, as in other previous studies (Carstocea et al., 2019, Rusu et al., 2019, Rusu et al., 2020). The planar reconstructions and three-dimensional volume renderings were evaluated. Relevant anatomical features were exported as image files. The patients have given written informed consent for all medical data to be used for research and teaching purposes, provided the files are anonymized.

RESULTS

In the lot of 41 patients documented retrospectively were found and classified five types of NMC/SPMC (figs.1,2): (a) type I – median, long NMC/SPMC, descending into the NPC; (b) type II – inclined, long NMC/SPMC, descending into the NPC; (c) type III – median, short NMC/SPMC, above the NPC; (d) type IV – median, short NMC/SPMC, absent NPC; (e) type V – inclined, short NMC/SPMC, absent NPC.

The distribution of the anatomical patterns is presented in figure 3. Type I was found in 51.22% of cases, type II in 2.44%, type III in 21.95% of cases, type IV in 4.88% of cases, and type V in 19.51% of cases. In 6/10 male cases was found the type I of NMC/SPMC. In males was not found the type IV – median crest with absent NPC. In 15/31 female cases was found the type I of NMC/SPMC (fig.4). In 10/41 cases (24.39%) were found absent NPCs/ICs.

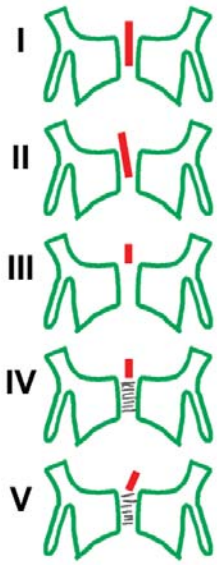

Figure 1. Anatomic diagrams (coronal view of nasopalatine canals) of the nasomaxillary/septo-premaxillary crest types (I-V), as resulted from the present study

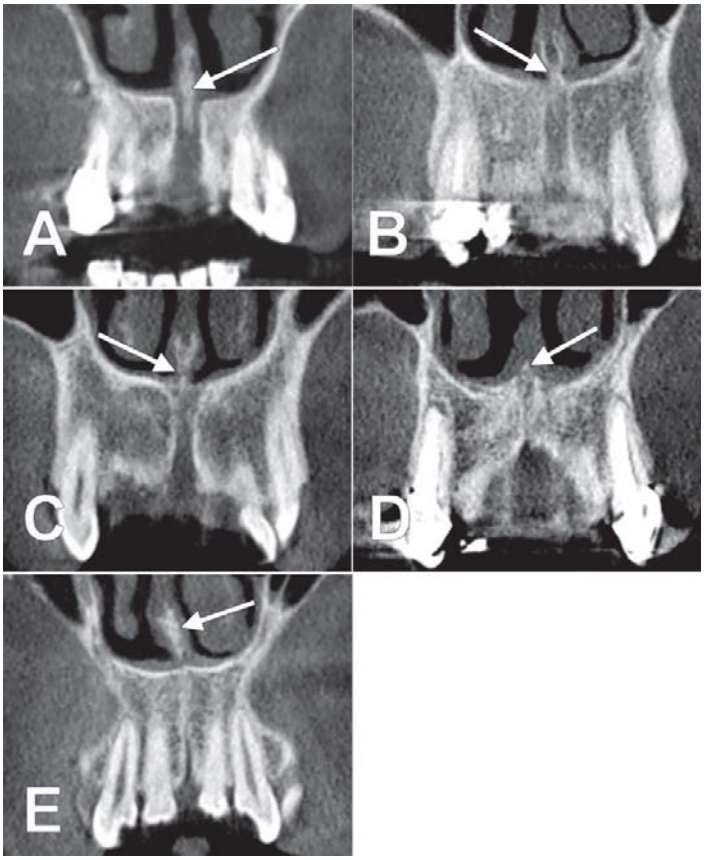

Figure 2. Morphological possibilities of the nasomaxillary/septo-premaxillary crest. Orthogonal coronal Cone Beam CT slices. A. Type I. B. Type II. C. Type III. D. Type IV. E. Type V

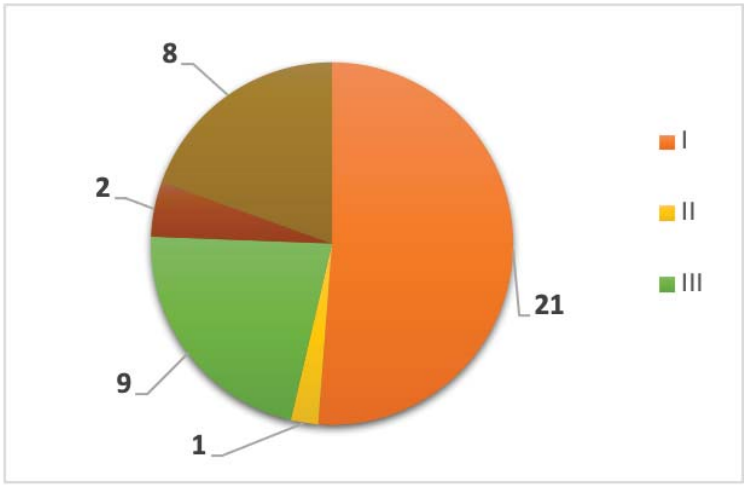

Figure 3. Prevalence (number of cases) of the morphological types I-V of nasomaxillary/septo-premaxillary crest (N=41 cases)

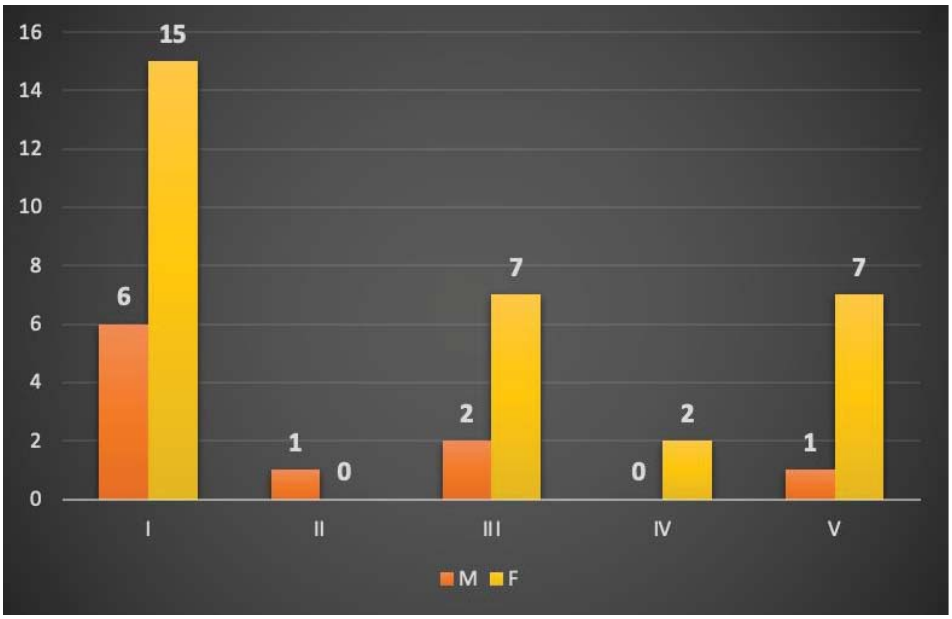

Figure 4. Repartition of cases on genders (M: male, F: female) and types (I-V) of the morphology and topohraphy of the nasomaxillary/septo-premaxillary crest (N=41 cases)

DISCUSSIONS

The sub-vomerian ossification centre of Rambaud and Renault, or the centre of Huschke, or the infravomerine process, belongs to the premaxilla (Fawcett, 1911, Stout and Collett, 1969). It is wedged in between the incisive and palatine elements beneath the vomer bone and it explains the Y shape of the upper arms of the NPC/IC (Fawcett, 1911). This centre bona fide corresponds topographically to the further NMC/SPMC crest. The growing nasal septal cartilage plays a certain role in midfacial growth and the pressure resulted from this growth is transmitted to an anterior traction force via the septo-premaxillary ligament (Al Dayeh and Herring, 2014). It was discussed that the upper labial frenulum is not just a mucous fold without physiologic importance but it contains the extension of the septo-premaxillary ligament to the upper lip (Hall and Precious, 2013). Therefore, the osseous NMC/SPMC is incorporated within a nasal-labial traction system. Length variations of this crest, such as those determined by this study, could determine discrete functional differences of that nasal-labial traction system.

In cases with unilateral cleft lips there is a hypoplastic growth of the maxilla and pyriform aperture on the cleft side (Pan and Tatum, 2013). It is thought that both the septo-premaxillary ligament and the orbicularis oris muscle are of importance in development of nasal deformities (Pan and Tatum, 2013). The septo-premaxillary ligament is the only attachment of the premaxilla to the nasal septum at the vomero-premaxillary suture (VPS) (Chauhan and Sharma, 2019). Different histological studies found in the bone close to the VPS conglomerates of secondary cartilage with marked differences in the extent and type of cartilage (Friede and Morgan, 1976). Friede (1975) found small conglomerates of cartilage-like cells at the bony margins of the VPS, as well as of the inter-premaxillary suture (Friede, 1975). As the septo-premaxillary ligament is described as a column of cells descending from the NS (Latham, 1970), it is therefore reasonable to regard that ligament as ossifying, or condrifying later in morphogenesis.

CONCLUSIONS

The different anatomical possibilities of the NMC/SPMC revealed that the NPC/IC also has different appearances on coronal cuts, not just the"Y" shape. This comes in accordance with different previous studies (Abrams et al., 1963, Song et al., 2009) but also indicates an overlooked possibility: the absence of the NPC/IC. This latter needs a further documentation.

REFERENCES

1. Bornstein MM, Balsiger R, Sendi P, von Arx T. 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. 2011;22(3):295-301.
2. Radlanski RJ, Emmerich S, Renz H. Prenatal morphogenesis of the human incisive canal. Anat Embryol (Berl). 2004;208(4):265-71.
3. Latham RA. Maxillary development and growth: the septo-premaxillary ligament. J Anat. 1970;107(Pt 3):471-8.
4. Carstocea L, Rusu MC, Pascale C, Sandulescu M. Three-dimensional anatomy of the transantral intraseptal infraorbital canal with the use of cone-beam computed tomography. Folia Morphol (Warsz). 2019.
5. Rusu MC, Iacov-Craitoiu MM, Sandulescu M, Carstocea L, Stana DM. Constant features of the adult maxillary bone in the site of the premaxillary suture: the sutura notha, Macalister's foramina, Parinaud's canal, and the second angle of the canalis sinuosus of Wood Jones. Rom J Morphol Embryol. 2019;60(4):1097-103.
6. Rusu MC, Sandulescu M, Carstocea L. False and true accessory infraorbital foramina, and the infraorbital lamina cribriformis. Morphologie. 2020;104(344):51-8.
7. Fawcett E. The Development of the Human Maxilla, Vomer, and Paraseptal Cartilages. J Anat Physiol. 1911;45(Pt 4):378-405.
8. Stout FW, Collett WK. Etiology and incidence of the median maxillary anterior alveolar cleft. Oral Surg Oral Med Oral Pathol. 1969;28(1):66-72.
9. Al Dayeh AA, Herring SW. Cellular proliferation in the nasal septal cartilage of juvenile minipigs. J Anat. 2014;225(6):604-13.
10. Hall BK, Precious DS. Cleft lip, nose, and palate: the nasal septum as the pacemaker for midfacial growth. Oral Surg Oral Med Oral Pathol Oral Radiol. 2013;115(4):442-7.
11. Pan J, Tatum SA. Rhinoplasty for Cleft and Hemangioma-Related Deformities. Advanced Aesthetic Rhinoplasty: Springer; 2013. p. 699-709.
12. Chauhan JS, Sharma S. Lag screw fixation of the premaxilla during bilateral cleft lip repair. J Craniomaxillofac Surg. 2019;47(12):1881-6.

13. Friede H, Morgan P. Growth of the vomero-premaxillary suture in children with bilateral cleft lip and palate. A histological and roentgencephalometric study. Scand J Plast Reconstr Surg. 1976;10(1):45-55.
14. Friede H. A histological and enzyme-histochemical study of growth sites of the premaxilla in human foetuses and neonates. Arch Oral Biol. 1975;20(12):809-14.
15. Abrams AM, Howell FV, Bullock WK. Nasopalatine cysts. Oral Surg Oral Med Oral Pathol. 1963;16:306-32.
16. Song WC, Jo DI, Lee JY, Kim JN, Hur MS, Hu KS, Kim HJ, Shin C, Koh KS. 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. 2009;108(4):583-90.