**ORIGINAL ARTICLE** 



# Alveolar Recess Cell (ARC): A Newly Described Intra Maxillary Sinus Cell with Variable Pneumatisation of Alveolar Process of Maxilla

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#### Abstract

Anatomical variations in the maxillary sinus pneumatisation are limited unlike the ethmoids. We present rare variations of the maxillary sinus along its floor other than septations and includes wide pneumatisation of alveolar and palatal recess with cell formation. An intra-maxillary cell that opens into the maxillary infundibulum well within the sinus is described here and our senior author has coined the new term-alveolar recess cell. Its involvement in the sinus pathologies and additional surgical approaches for the disease clearance is discussed here.

Keywords Alveolar recess cell  $\cdot$  Pneumatisation  $\cdot$  FESS  $\cdot$  Inferior meatal antrostomy  $\cdot$  Pre lacrimal  $\cdot$  CT PNS  $\cdot$  Fungal sinusitis

#### Introduction

Maxillary sinus is the most described sinus in terms of its anatomy since it was first mentioned as early as 1489 by Leonardo Da Vinci [1]. Unlike the ethmoids, variations are often limited to presence of accessory ostium, Haller cell, septations and aplasia/hypoplasia of the sinuses [2]. The sinus floor (SF) is formed by the alveolar process of maxilla and the most common anatomical variation there is the septations either bony or fibrous, complete or incomplete [3].The embryological origin of the maxillary sinus as an out pouch from the ethmoid infundibulum [1]and the secondary pneumatisation of the sinus that can vary based on

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the dentition, makes the sinus floor especially the alveolar recess susceptible to developmental variations like the localised sinus pneumatisation (LSP) at the tooth sites [4].Here we report an isolated alveolar recess cell which was infected with fungal ball along with the rest of the maxillary sinus and the requirement of a separate inferior meatal approach along with middle meatal antrostomy for disease clearance. Similar intra maxillary sinus cells was also noted in the CT scan along the antero lateral wall extending into the alveolar recess which differed from the septations described before. We report a new entity of a complete intra maxillary sinus cell centered in the alveolar recess and our senior author has coined the term alveolar recess cell for the same.

#### **Case Reports**

 34 year old male was diagnosed with allergic fungal rhinosinusitis as plain computed tomography (CT) scan of the para nasal sinuses(PNS) (Fig. 1)showed complete opacification of left maxillary, ethmoid, frontal and sphenoid sinus with hetero densities suggestive of fungal aetiology. It also showed a Haller cell, Bent and Kuhn type III supra agger frontal cell (SAFC) and a type II suprabullar frontal cell (SBFC) on the left side. A new ovoid cell was noted along the left maxillary sinus floor pneumatising the alveolar process medial to



Fig. 1 Plain CT scan PNS-coronal and sagittal image showing a left aveolar recess cell

**Fig. 2** 1<sup>st</sup> image shows inferior meatal antrostomy done just behind the pyriform aperture with the removal of anterior end of inferior turbinate bone. 2<sup>nd</sup> image shows the alveolar recess cell inferiorly opened, rest of the maxillary sinus seen superiorly



the canine root extending till the midline expanding into the alveolar recess and opening postero laterally into the sinus, ultimately draining into the middle meatus. This new cell was named as an alveolar recess cell and was found to be hyper dense in T1W images with double density sign as the rest of the left maxillary sinus.

Patient underwent full house functional endoscopic sinus surgery (FESS) with a left middle meatal antrostomy (MMA), opening of Haller cell and maxillary sinus wash for clearance of fungal debris was done along with clearance of other sinuses. However, the alveolar recess cell was not accessible even through a wide middle meatal antrostomy and the view with even a 70 degree rigid Hopkins rod endoscope was limited. This new cell was accessed via an infra lacrimal inferior meatal antrostomy just behind the pyriform aperture with drilling off the bony superior cell wall that was in line with the floor of the rest of the sinus. This opened the left alveolar recess area (Fig. 2) where fungal debris with polypoidal mucosa was found and the same was removed under endoscopic vision. Biopsy confirmed it to be allergic fungal polyposis with PAS and GMS fungal staining s/o Aspergillus species.

Fig. 3 Bilateralal alveolar recess cells





**Fig. 4** Pneumatization of the para median alveolar process (forming palatine recess) causing both maxillary sinus to meet in midline separated only by a plate of bone

- 2) Plain CT scan of the PNS (Fig. 3) shows a cell in the bilateral alveolar recess where superior border is the nasal floor, inferior and medial wall is by the alveolar and palatine process of maxilla, and postero-laterally opening into the rest of the sinus cavity. It also has a Haller cell on the right side.
- 3) Another scan (Fig. 4) shows bilateral large palatine recesses with complete pneumatisation of the entire alveolar process which forms the floor of the maxillary sinus and nasal floor with both sinus separated in the midline by only a small septation of the hard palate.
- 4) Fig. 5 shows a plain CT scan showing opacification of the right alveolar recess and inferior part of the maxillary sinus separated from the rest of the sinus by a huge

Haller cell. Intra operatively it was found to be fungal debris and an inferior meatal wide antrostomy just posterior to the pyriform aperture was done to clear the disease.

### Discussion

The primordial maxillary sinus develops along with the primitive ethnoidal infundibulum at around 14 to 17 weeks of intra uterine life between the uncinate process and bulla ethnoidalis [5].Maxillary sinus develops as an extra capsular extension from the ethnoids into the adjacent membranous bone outside the nasal capsule by epithelial extension of diverticula [6].The primary pneumatisation is complete at birth whereas the secondary pneumatisation which include

**Fig. 5** Case of fungal sinusitis involving right alveolar recess separating it from the rest of the sinus by a huge haller cell



the localised aeration of para nasal recesses and expansion of the sinus cavity occurs by around 20years of age. It attains a pyramidal shape with the apex pointing laterally and the pneumatisation of its 3 recesses - infra orbital, zygomatic and alveolar recess and a fourth variable palatonasal recess is also dependent on the development of dentition [1] [3]. The maxillary sinus drains into the maxillary infundibulum that lies totally within the sinus cavity which in turn opens via the maxillary ostium into the ethmoid infundibulum in the middle meatus [5]-the ultimate drainage pathway of all anterior para nasal sinuses.

The most common anatomical variation noted in the inferior and lateral part of the sinus are the septations first described by Underwood et al [3]. Transverse septations are rare compared to septations in the sagittal plane and these are often considered as extensions of ridges and arise in between the dental roots. Ridges play an important role where it was noted that alveolar ridge preservation(ARP) after maxillary molar extraction is thought to reduce secondary sinus pneumatisation [7]. Figure 3 in our case shows B/L alveolar recess cell opening postero laterally into the maxillary sinus. It is different from the septation seen as it is noted in more than one plane though walls correspond to the sinus walls itself. Figure 5 shows the CT scan of a patient with fungal sinusitis involving the alveolar recess alone probably a huge Haller cell separating it from the rest of the sinus.

The palatine process pneumatisation(PTP) was extensively documented recently by Serindere et al. where 3 types of PTP was noted based on alveolar ridge pneumatisation, palato nasal recess angle (PRA) and palatal junction angle (PJA) [8].More acute palato nasal recess angle with less alveolar recess height is noted in type III PTP and greater pneumatisation of the palatine recess of the sinus. Figure 4 in our case shows a similar acute angulation of the palatonasal recess with extensive pneumatisation of palatine recess where the either side recesses are separated only by a small septa. Such cases will require an additional infra meatal approach for clearance of maxillary sinus pathologies. Other popular approaches include canine fossa trephining, Caldwell Luc's and pre lacrimal approaches.

However, isolated cells in the palatonasal recess or a single cell pneumatising the alveolar ridge as reported here is for the first time. Such cells reported earlier is along the ethmoid infundibulum draining into it directly as in the case of anterior ethmoid cells like Haller cell or Agger nasi cell. Posterior ethmoid cell pneumatising maxillary sinus usually drain into the superior meatus, called the ethmo-maxillary sinus. There was also a supra maxillary cell noted by our senior author Ahilasamy et al., which drained into the middle meatus reported first in 2022 [9]. Such abnormal extra capsular pneumatisation can co-exist with maxillary sinus hypoplasia with a variable prevalence of 14–22% as reported by Khanobthamchai et al., Ozcan et al.

The new ovoid cell pneumatising the area of palatine and alveolar recess in Fig. 1 is radiologically described as follows:

- 1. Superior bony wall is seen adjacent to the floor of the nasal cavity and extending into the corresponding level of maxillary sinus as a horizontal septation.
- 2. Inferior wall is seen along the superior surface of the alveolar process anteriorly and the horizontal plate of palatal bone posteriorly.
- 3. Medial wall corresponds to the inter maxillary and mid palatine suture lines and the medial part of this cell occupies the area of the palatine recess. Anteriorly there

is a small area of alveolar bone separating it from the anterior nasal spine area.

- 4. Lateral wall is seen abutting the left canine tooth and posteriorly corresponds to infero-lateral wall of the maxilla.
- 5. Anteriorly the cell is seen just posterior to the incisor tooth with the alveolar process corresponding to its anterior wall.
- 6. Posterior wall is a bony septum which is incomplete and is seen in the alveolar recess with an opening into the rest of the sinus supero-laterally.

The walls of the cells and the extension in multiple planes differentiate it from the septations seen in these areas. In our case, this cell also had fungal debris that was not approachable even with a wide middle meatal antrostomy. A pre lacrimal approach through the inferior meatus and drilling the roof of the cell with an angulated trans-nasal burr opened up this cell to clear the disease within. The CT scan thus helped in planning the surgical approach and also opening up a hidden area of local pneumatisation of the maxillary sinus. Appropriate preoperative planning is required in such cases with rare anatomical variation to ensure complete disease clearance and prevent revision sinus surgeries.

# Conclusion

The knowledge about rare variations in the anatomy of the maxillary sinus especially along the floor is important to plan other endoscopic approaches along with middle meatal antrostomy. Often an inferior meatal antrostomy just behind the pyriform aperture can avoid a Caldwell Luc's approach for the complete clearance of the disease especially in cases of fungal sinusitis. The presence of the new cell occupying the alveolar and palatine recess which required drilling its superior wall to remove the fungal debris within shows the importance of a thorough reading of CT scan of the PNS pre operatively for surgical planning. This newly described intra maxillary cell is named as an alveolar recess cell by our senior author.

#### Declarations

**Disclosure of Potential Conflict of Onterests** Author 1, author 2, author 3 and author 4 declare that they have no conflict of interests.

**Statement of Human Rights** 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.

**Informed Consent** Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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