Chapter Two

Surgical Anatomy of the Lateral Nasal Wall
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In order to understand the pertinent surgical anatomy for endoscopic sinus surgery it is paramount to study the complex anatomy of the lateral nasal wall of the nose. The ethmoid sinuses and their relations to other paranasal sinuses, osteomeatal complex as well as the relations to the vital structures, cribiform plate, dura and roof of the ethmoid above, orbit, lamina papyracea and optic nerve laterally.

The most prominent features of the lateral nasal wall in the sagittal view are the turbinates, usually three, occasionally four, in number i.e. superior, middle and inferior turbinates with their corresponding meati (Fig1).

Fig 1. Showing turbinates and hiatus semilunaris

They are delicate scrolls of bone, covered by ciliated columnar epithelium. The inferior meatus houses the opening of the nasolacrimal duct in the anterior third. This duct courses from the lacrimal sac under the agger nasi cells to its opening under the anterior end of the inferior turbinate about 3-4cm from the anterior nares (1).

The ostias of anterior sinuses e.g. frontal, anterior ethmoidal and maxillary lies in the middle third of the lateral nasal wall, under the middle turbinate, termed as osteomeatal complex by Nauman (2), referring to the area bounded by the middle turbinate medially, lamina papyracea laterally and the basal lamella superiorly and posteriorly, the inferior borders being open. This description denotes that OMC is more of a functional entity rather than an anatomical unit, representing the final common pathway for drainage and ventilation of the frontal, anterior ethmoid and maxillary sinuses. (Fig 2)

Fig 2. OMC and attachment of middle turbinate
Anteriorly there is a thin bony leaflet resembling a hook called uncinate process, a part of the ethmoid bone orientated sagittally and runs in anterosuperior to posteroinferior direction (Fig 3).

Behind this lies semilunar groove called Hiatus Semilunaris. The uncinate process is one of the three downward vertical projections of ethmoid bone (The other two are the perpendicular plate and the middle turbinate) and articulate inferiorly with the ethmoid process of the inferior turbinates. Posteriorly and superiorly the uncinate process is free and is covered by the membranous area of the lateral wall called the posterior fontanelle. Similar membranous area is present anterior and inferior to the uncinate process called anterior fontanelle. The fontanelles may be sites of accessory maxillary ostia.

The ethmoid air cells system is classified on the basis of the anatomy of the ground lamella and various ostia of the ethmoid sinuses (3). The ethmoid bone lies in the midline bounded superiorly by the frontal bone, posteriorly by the sphenoid and orbits laterally. It contributes to the septum via perpendicular plate inferiorly and ends up superiorly as crista galli. The cribiform plate forms the horizontal part, terminating in the lamina papyracea, lies between the crista galli and the basal lamella of the middle turbinate (Fig 4-5).
The basal lamella are horizontal shelves of the bone attaching the middle turbinate to the lamina papyracea. The most prominent is named, the ground lamella separates the anterior ethmoidal sinus from the posterior ethmoid sinus. In adults the ethmoid sinus measures 4-5 cm anteroposterior, 2.5 cm in height and 0.5 cm wide anteriorly and 1.5 cm posteriorly. (4) The ethmoid labyrinth usually contains 7-11 air cells, the largest and most non-variant air cells in the anterior ethmoid complex is the ethmoid bulla. It is formed by the pneumatization the bulla lamelle or second basal lamella and is like a blob on the lamina papyracea (5). Above the bulla lies the suprabullar recess (sinus Lateralis) a potential space that may leads to a retrobullar recess. The space is bordered superiorly by the ethmoid roof, laterally by the lamina papyracea, inferiorly by the roof of ethmoid bulla and posteriorly by the basal lamella of middle turbinate (Fig 4 & 6a).

There is a clear and distinct separation both embryologically and in the muscociliary transport-mechanism of the anterior and posterior ethmoid by the ground lamella of the middle turbinate. The most anterior superior insertion of the middle turbinate is adjacent to the christa etmoidalis, which produces anterior bulge, known as agger nasi cells. The posterior end of the middle turbinate is attached to the perpendicular process of the palatine bone (lamina perpendicularis) (6). The anterior third of the middle turbinate inserts vertically into the skull base at the lateral edge of the cribriform plate. The middle third turns laterally to be attached to the lamina papyracea. The posterior third, generally becomes horizontal and is attached to the medial wall of the maxillary sinus and the lamina papyracea and forms the roof of the most posterior part of the middle meatus. Sometimes, the middle turbinate may also contain one or more air cells. This anomaly is called conchum bullosa. This may drain into an ostea posteriorly in the middle meatus.

The Hiatus Semilunaris is a crescent shaped cleft that lies in the middle meatus and is bounded by the uncinate process anteriorly and by the anterior surface of the ethmoid bulla posteriorly. The suprabullar and retrobullar recess can be entered medially and inferiorly underneath the middle turbinate through the hiatus semilunaris. (Fig 6b)
The ethmoid infundibulum is the anterior most part of the anterior ethmoid cells. It is bordered medially by the uncinate process and laterally by the lamina papyracea. Posteriorly the ethmoid infundibulum extends to the anterior face of the ethmoid bulla and opens into the middle meatus through the Hiatus Semilunaris inferiorly. It houses the maxillary sinus ostium usually found at the floor of lateral aspect of infundibulum and remains hidden under the middle turbinate in the middle meatus, lateral to the uncinate process. The drainage from this area is usually seen in the middle meatus.

The frontonasal recess usually opens at the apex of the Hiatus Semilunaris into the infundibulum. Superiorly the ethmoid infundibulum may end blindly in the terminal recess or the recess terminalis. The maxillary and frontal sinus infundibulums are within the respective sinuses. The frontal infundibulum is a funnel shaped narrowing of the inferior aspect of the frontal sinus towards the floor of the frontal sinus ostium. Similarly the maxillary infundibulum is a funnel shape narrowing of the lumen of the maxillary sinus towards the natural ostium, though it does not narrow significantly.

In the sagital section the frontal sinus, frontal ostium and nasal frontal recess resemble an hourglass. The medial wall of the frontal recess is the most anterior and superior part of the middle turbinate; most of the lateral wall is made of lamina papyracea. The frontal recess is the most anterior and superior part of the anterior ethmoid complex. From here the frontal bone is pneumatized resulting in a frontal sinus. Frontal recess narrows towards the ostium but then widens in inferior and posterior direction (Fig 7-9) Sometimes this communication is narrowed and resembles a duct on the CT Scan. This is due to enlarged size of the ethmoid bulla or bulla lamelle or by an excessive pneumatization of agger nasi cell. Furthermore the frontal recess may harbour the supraorbital cell of frontal recess as a result of pneumatization of supra orbital cells. This may vary from one to seven in numbers.
Posterior ethmoid cells are two to five in numbers and lie posterior to the ground lamella. Superiorly they are in relation to the dura, posteroinferiorly to the sphenoid sinus and laterally to the orbital apex and the optic nerve. The posterior ethmoidal cells drain into superior meatus at its anterior recess.

Posterior cells can be pneumatized laterally and superiorly to the sphenoid sinus, called sphenoethmoid cells or Onodi cells. The optic nerve and carotid artery may be exposed in an sphenoethmoid cell (Onodi cell) (Fig 10-11). The clinical significance of this should be born in mind while operating in the area more over one should always bear in mind that the posterior part of the lateral wall of the ethmoid sinus curves inwards, therefore one should turn the instruments inwards and medially to avoid accidental damage to the optic nerve.

The Sphenoid Sinus is usually an unequal pair of sinuses located posterior to the posterior ethmoidal sinus. The sphenoid sinus shows variation in size as well as the location of intersphenoidal septum. The anterior wall of the sphenoid sinus is about 7.15 cm from the columella or inferior nasal wall. The internal carotid artery and optic nerve impression on the lateral wall of the sphenoid sinus is visible in the well pneumatized sinuses. The roof of the sphenoid sinuses presents a convex bulge corresponding to the floor of the pituitary fossa (Fig 12-13).
The anterior ethmoid artery lies in the roof the ethmoid sinus just posterior to the nasofrontal recess. The anterior ethmoidal artery, a branch of the ophthalmic artery leaves the orbit via anteroethmoidal foramen, crosses the roof of the anterior ethmoidal sinus and supplies the anterior ethmoidal cells and frontal sinuses. (7). The artery then enters the anterior cranial fossa gives off the meningeal branches and thereafter turns downwards into the nasal cavity through the slit by the side of christa galli and returns to the roof of the nose through the cribiform plate. The anterior ethmoidal artery supplies the anterior third of the lateral wall of the nose and the corresponding part of the septum. The sphenopalatine artery, a branch of internal maxillary artery enters the nose through the sphenopalatine foramen located in the posterior part of middle meatus between the ethmoid crest and lamina perpendicularis of the palatine bone.

References
5. Turner A L, Porter WG: The structural type of the mastoid process based upon the skiagraphic examination of one thousand crania of various races of mankind. Journal of Laryngology 27:115-121, 1921