Welcome to the Functional Endoscopic Sinus Surgery

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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 structure, 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 (Fig 1).

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 sagitally 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 cribriform 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.

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. 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.

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 sagittal 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 supraborital 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, posteriorinferiorty 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 sphenethmoid 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 cribriform 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.

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Examination of the nose with an endoscope is an important diagnostic modality that yields helpful information while evaluating the patients with sino-nasal diseases (1). The advent of Hopkins nasal endoscopes has enhanced the methods of nasal examination. It has significantly improved our understanding of nasal anatomy, physiology, and pathophysiology and revolutionized the management of sino-nasal diseases (2). Nasal endoscopy is routinely applied not only to examine the nose, photograph and document, the normal & variant anatomy and the gross pathology in todays otolaryngological clinics around the word but also used as an essential teaching and training tool.

The nasal endoscopic examination is performed in the clinic after the anterior rhinoscopy has been performed. The nasal cavity is sprayed with 2% lidocaine with phenyl epinephrine a few minutes before examination is performed. The 0-degree & 30-degree scopes are used. The 2.7mm diameter scopes are preferred over 4 mm diameter as the former is better tolerated. The patient is sitting straight with head rested on the headrest in the sniffing position. The telescope is introduced under the direct vision without making contact with the walls. Endoscope is dipped in an antifog solution before its introduction into the nose. On the first pass the scope is introduced between the septum and the inferior turbinates and advanced till the posterior choana, inspecting the inferior meatus, eustachian tube orifice, fossa of Rosen Muller and nasopharynx. Through a longitudinal rotation this allows the overview of entire nasopharynx and the eustachian tube orifice on the other side.

The second pass is made along the middle turbinate and septum to the upper edge of the posterior choana and then rolled over the posterior end of the middle Turbinate into the spheno-ethmoidal recess. The superior turbinate & in some cases, the supreme turbinates and corresponding meatus are visualised. The sphenoid sinus ostium may be seen in certain cases.

The third pass is in the middle meatus after retracting the middle turbinate medially. The uncinate process, bulla ethmoid and ethmoid infundibulum and the frontal recess is inspected. Along with it the obvious pathology and anatomical variations are inspected. The natural maxillary ostium is normally hidden in ethmoidal infundibulum towards the back end of the hiatus semilunaris. The accessory ostium may be found in the anterior or posterior fontanelle.

Nasolacrimal duct may be identified in the inferior meatus by gently massaging the lacrimal sac of the patient and visualising the tears in the inferior meatus.

The goal of the nasal endoscopy is to identify the normal anatomy, normal variants, pathology and hidden malignancy. Precise documentation of the findings together with clinical photographs if possible should be documented (Fig.1 to Fig.23).
In the post operative period one can clean all the crustations in the operated area under the direct vision with the help of telescope, improve & augment healing (Fig.24).

Endoscopic examination is a simple non invasive technique which helps to identify deviated nasal septum, hypertrophied turbinates, obstructed maxillary sinus ostia, high septal spur, polyps, synchieae, concha bullosa, accessory ostia, bulla ethmoidalis, antrochoanal polyps, mucocele, foreign bodies, congenital atresia, chronic and acute sinus infections, paradoxical and bifid middle turbinate, bent uncinate process CSF leaks, fungal sinus diseases and neoplasms. A comparative study of the diagnostic value of nasal endoscopy with conventional methods found it to be a superior method of examination, indeed most of its findings were comparable with CT findings!(9).

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Chapter Five

Imaging of Paranasal Sinuses and Nose

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Radiographic imaging of the nasal cavity and para nasal sinuses are essential for evaluation and planning. The routine imaging has been used for more than 5 decades, by the physicians, they correlate well only in acute sinusitis, indicated by air fluid level. Accurate assessment of the bony framework, soft tissue, anatomical variation, inflammatory and other pathological lesion of the paranasal sinuses and nasal cavity has been only possible with increased availability of CT scans. On the other hand MRI provides more information about soft tissue of the face, head and neck, skull base and central nervous system.

The primary object of CT scan is to provide a road map for endoscopic sinus surgeon by identifying the normal anatomical landmarks and variant anatomy as well as to aid the diagnosis of pathological conditions(1). Though the nasal endoscopy reveals considerable anatomical and pathological information, the extent of the disease together with the surrounding anatomy can only be evaluated by the CT scan employing coronal and axial images. The work of Hilding (2), Proctor (3) and Messer Kilinger (4) on the mucociliary clearance and air flow in the nose and sinuses point out the importance of osteomeatal complex in the pathogenesis of the sinus disease.

The successful outcome of the endoscopic sinus surgery depends upon the evaluation of pathological changes, an anatomical definition of the osteomeatal complex by CT and the re-establishing of the mucociliary clearance and ventilation of the sinuses with functional endoscopic sinus surgery by limited resection and preserving the sinus mucosa which will become normal hence afterwards.

The osteomeatal complex, the ethmoid sinuses, maxillary sinuses and its ostium sphenoid sinuses, frontal recess and agnasi cells, middle turbinate, uncinate process, and the basal lamella are best visualised by the coronal plane i.e. Direct coronal CT scanning (Fig 1-3).

Fig.1. Frontal sinuses

Fig.2. Middle turbinate and basal lamella

Fig.3. Sphenoid sinuses

The axial images are excellent to show the vital structures such as carotid artery, optic nerve and the relation of posterior ethmoidal cell such as Odoni cell to the optic nerve and Sphenoid Sinus (Fig 4).
The Ostiomeatal complex is defined as the physiological unit providing airflow and mucociliary clearance to the maxillary, ethmoid, frontal and sphenoid sinuses. Anatomically the otolaryngologist refers this area bounded medially by the middle turbinate, laterally by the lamina papyracea and uncinate process, the basal lamella superiorly and posteriorly. The inferior and anterior borders are open (Fig 5-6).

The coronal CT scan of the paranasal sinuses is performed with the patient in the prone position with the head hyper extended, 3mm of thin coronal section are obtained from the frontal sinus to sphenoid sinus. The CT scan images should be photographed on bone (average 2000H windows) setting as well as soft tissue (average 250H windows) settings. The bone windows settings are best to define the detailed anatomy as well as pathology of the OMC, ethmoid sinus, uncinate process, the frontal recess, the frontal and the sphenoid sinus. However the soft tissues setting will help the physician to evaluate the pathological changes in the orbit, intracranial as well as in the nose and sinuses.

The frontal sinus appears at the age of 8 years on the X-ray. The Frontal sinuses are the most variable in size and are asymmetrical. They are aplastic in 17% of various European races, in 12% of Continental European races, in 35% of other races and 52% Eskimos. The frontal sinus drains via the frontal infundibulum to the frontal sinus ostium and then into the frontal recess, thus making an hourglass appearance (Fig 7-8).

The CT scan appearance of a disease frontal sinus may vary from membrane thickening to complete opacification (Fig 9-10a).
In acute cases an air fluid level may be visible. Mucocele appears as an opacification and expansion of the frontal sinus with the loss of haustrations septas. The osteomyelitis of the frontal sinuses will appear as Pots puffu tumours (Fig 10b).

The nasolacrimal duct appears as a vertically oriented tubular structure with well defined cortical margins filled by soft tissue, extending from lacrimal fossa to the level of the inferior turbinate (Fig 11).

Recognition of the importance of OMC has increased the role of the radiologist to evaluate and identify different anatomical anomalies as well as pathological process in this key area. The ethmoid is a delicate bone which articulates with thirteen bones, the frontal, the sphenoid, the nasal bone, the maxilla, the palate, the vomer and the inferior nasal conchae (5). The ethmoid bone consists of four parts e.g. a perpendicular plate, two labyrinths and a horizontal plate, called the cribriform plate. Each ethmoid labyrinth comprised of vertically oriented air cells up to eighteen in number that are separated so that they form honey comb of mucosa lined spaces that drain into each other (6). The most prominent air cell is bulla ethmoidalis, bordered anteroinferiorly by the hiatus semilunaris and infundibulum from back to front respectively. The lamina papyracea forms the lateral wall of the ethmoid sinus. The supra bullar recess may lead to a space superio-posteriorly, between the posterior wall of the bulla ethmoidalis and basal lamella called sinus lateralis (Fig 12 -13).
The ostia of ethmoid sinus cannot be visualised by CT scan. The anterior, most intramural, ethmoidal cells are the frontal recess cells. The infundibular cells are the next most anterior ethmoidal cells, from here arise the agger nasi cells, located immediately anterior to the anterior end of the middle turbinate. Just inferior and posterior to the agger nasi cells lies the uncinate process, a boomerang shaped bone subjected to considerable variation. It is about 1-4 mm wide and 14-22 mm long, forms the medial boundary of the hiatus semilunaris (7). As it progresses posteriorly it forms the inferior border of the hiatus semilunaris and the medial wall of the infundibulum. The infundibulum is trough shaped cavity below the bullae and above and lateral to the uncinate process (Fig 14-17).

Within the nasal cavity three scrolls of bone on the lateral of the nose, covered with ciliated respiratory mucosa are the inferior, middle & superior turbinates, divide the nasal passage into the corresponding meati. The inferior turbinate is
usually the largest and separate bone while the superior conchae are the parts of ethmoid bone. The nasolacrimal ducts open in the inferior meatus.

The superior turbinate is the smallest and anchored superiorly to the cribiform plate. The middle turbinate attaches to ethmoid roof at the lateral lamella of the cribiform plate anteriorly via ground lamella. The middle turbinate inserts laterally to the lamina papyracea via the basal lamella posteriorly. The fovea ethmoidalis is separated from the cribiform plate by the ground lamella of the middle turbinate. The fovea ethmoidalis, normally is situated at a higher level, occasionally this may be reversed and worthy of notice to avoid the potential complications during surgery. The most common anatomical variation is the pneumatization of the middle turbinate called conchum bullosa and is present in about 30% of the patients (Fig 18-19).

![Fig.18&19. Conchum bullosa](http://endoscopicsinussurgery.co.uk/chapterfive.html)

This may occur on one side or both side (7). The uncommon variant are Odoni cell and Haller cells (Fig 20).

![Fig.20. Haller cells narrowing the OMC](http://endoscopicsinussurgery.co.uk/chapterfive.html)

The ethmoid sinuses are the commonest site for inflammation manifested as thickening of the mucosa. Mucocele of the ethmoid sinuses may present as proptosis or lateral displacement of the eye and most often involves the anterior ethmoid air cells (Fig 21-27).

![Fig.21&22. Mucocele of ethmoid sinus](http://endoscopicsinussurgery.co.uk/chapterfive.html)
Polyps appears as expansile masses with the opacification of sinuses and without the destruction of the bony walls. The malignancies will destroy the bony walls without remodelling and will enhance with contrast. Allergic fungal Sinusitis is manifested by the involvement of sinuses with area of attenuation between 180-320 Hounsfield units surrounded by an area of hypointensity, thus creating double density due to the concretion surrounded by allergic mucin (Fig 28-30).
The sphenoid sinus is the most posterior sinus with a variable pneumatization and septation. They start pneumatization after the age of three years and grow to an average adult size of 2cm high and 2.3 cm deep and 1-7 cm wide. The internal carotid artery and optic nerve are adjacent to the posterolateral aspect of the sphenoid sinus and may produce two corresponding bulges, on occasions the bony wall may be deficient (8). Acute sinusitis may be represented by the fluid level and the polyps in allergic fungal sinusitis may also involve the sphenoid sinuses and may erode through the walls into the surrounding structures (Fig 31).

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Chapter Seven

Post Operative Care

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Planning for postoperative care starts during the surgery. The common problem leading to obstruction of the outflow at the ostiomeatal complex is usually the tendency of adhesion formation between the middle turbinate and lateral nasal wall. At the termination of procedures, middle meatus should be left as wide as possible (1). An attempt is made to restore the normal anatomy by minimising the trauma to the turbinates. For the concha bullosa or an enlarged and oedematous middle turbinate I use diathermy needle on the incision line before reducing the middle turbinate to minimise the bleeding as the instrumentation of this narrowed part is difficult with the crushing forceps and may lead to the development of adhesions.

I invariably pack the nose with mercels dressing soaked with Naseptin ointment for three to four hours or with rapid rhino absorbable dressing, while others believe not to pack the nose. As most of the cases are done under GA in the UK we tend to extubate the patients when they are still in deep sleep as the bleeding may start if the patient is coughing and bucking. For GA most of us prefer LMA over the traditional endotracheal tube. Patients may be discharged on the same day if there is no bleeding after removing the pack. The patients with medical problems need to stay overnight to stabilise their condition.

There is considerable diversity in the postoperative treatment. I like to use broad-spectrum antibiotics if pus is found at the time of surgery. For simple nasal polyps I tend not to use antibiotics except when the surgery time has increased & is complicated by prolonged bleeding. For allergic fungal sinusitis I start the steroids and anti-histamine as soon as the diagnosis is made. I also like to start the nasal douching with alkaline saline nasal douches two to three days post operatively accompanied by the steam inhalation. Decongestants drops may be used for one to two weeks to minimise discomfort. The mixture should not irritate or sting when being used. The patient may be able to make his own irrigation by adding one teaspoon of soda bicarb in one litre of water or alternately already made sinus rinse douching can be used. This may be continued for three to four weeks to discourage the crustations and until the healing has occurred.

The patient should be seen at the end of the second week. The nose is then sprayed with 2% lidocaine with Phenylephrine and a thirty-degree scope with a 2.7mm diameter is passed to visualise the healing process. The examination is performed while the patient is in a sitting position and the standard three passes are made to visualise the nose, lateral wall and ostiomeatal complex. All the crustations are cleared by suction (Fig 1-4). The nasal douching continues afterwards if required. Our routine follow up spans a period of six weeks in view of the fact that after surgery the mucociliary functions at the ostiomeatal complex are impaired for six weeks. During this period, fibrin, mucous secretions and blood clots tend to stick within the nasal cavity and ostiomeatal complex area, causing patients discomfort and predisposing to post operative infection and scarring (2).

Fig 1+ 2: Crustation in the maxillary ostium
Apart from synechia in the ostiomeatal complex, other factor which may result in poor healing are post operative infection, stenosis of maxillary sinus ostium, frontonasal recess and sphenoid sinus ostium as well as recurrence of polyps (3). Due to frequent complications of synechia or lateralization of middle turbinate some surgeons have used barriers or splints within the ostiomeatal complex to prevent these complications. We believe that such barriers are potentially capable of causing retention of clots, increase risk of infection and delay healing. However if adhesions are already present, after breaking them there is a case for such barriers insertion to prevent recurrence. For early recurrence of nasal polyps we recommend early application of steroid nasal spray (4)

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Chapter Eleven

Endoscopic Dacryocystorhinostomy (DCR)

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Over the past decade, with the advent of the endoscopic sinus surgery there has been renewed interest in the endoscopic DCR. Endoscopic DCR was first described by McDonogh (1). Since then the techniques have improved as the understanding of the anatomy and the ability to achieve reliable and consistent results have improved.

The endoscopic DCR is indicated in the management of epiphora that is associated with primary acquired nasolacrimal duct (NLD) obstruction or NLD obstructions secondary to infiltrate or inflammatory mechanisms and as a complication of previous nasal surgery or facial trauma. The contra-indications for endoscopic DCR are neoplasm obstructing the lacrimal flow, entropion, ectropion, punctal abnormalities and blepharitis.

Anatomy

The lacrimal excretory system consists of the main lacrimal glands, 10-12 secretory ducts, puncta, canaliculi, lacrimal sac and nasolacrimal duct. Tears are collected in the medial canthus, where they drain into the upper and lower puncta, 0.3mm opening situated about 5-6 mm from the canthal angle, on the summit of small papillae of the upper and lower eyelids. From each punctum the canaliculus passes vertically about 2mm to a receptacle called ampula. From ampula the canaliculus extends about 6-8 mm medially travelling through the orbicularis muscle before joining the lacrimal sac. The inferior and superior canaliculus formed together to form common canaliculus in 90-94% of the people before joining the lacrimal sac (2). During any probing procedure, the eyelid should be pulled laterally to straighten these channels to prevent injury. The common canaliculus and lacrimal sac are located between the anterior and posterior limbs of the medial canthal ligament. Prior to entry to the lacrimal sac the common canaliculus dilates slightly to form the sinus of Maier. It then enters the posterolateral wall of the lacrimal sac at the common internal punctum, creating an angle to form the valve of Rosenmuller. This prevents retrograde reflux of the tears from the sac (fig 1).

Fig.1: Lacrimal gland and lacrimal system

The lacrimal sac is a membranous conduit lined by modified nonciliated respiratory epithelium. On average it is 12-15 mm in height and extends 3-5 mm superior to the medial canthal ligament to form the fundus. It lies in the depression, the lacrimal sac fossa, formed by the frontal process of the maxillary bone anteriorly and a thin lacrimal bone posteriorly. Intranasally the lacrimal sac lies an average of 8.8 mm above the insertion of the middle turbinate (fig-2) (3).

Fig.2: The middle turbinate and lacrimal sac (dotted line)
The body of the sac extends from the level of canthal tendon down to the opening of the bony nasolacrimal canal. The duct travels within the bony nasolacrimal canal through the maxillary bone for approximately 11 mm, and continues 2-5 mm intranasally into the inferior meatus, 4-6 mm posterior to the beginning of the inferior turbinates (4). A fold of mucosa at the meatal termination of the duct forms the valve of Hanser. This helps to prevent the reflux of nasal material into the nasolacrimal duct.

**Surgical Technique**

Endoscopic DCR can be performed under local or general anaesthesia. Adequate local anaesthesia is achieved by installation of topical proparacaine or tetracaine in the conjunctival sac. Intravenous short-acting sedatives-hypnotics may enhance patient comfort. 2% xylocaine with 1:200 000 adrenaline or 0.75% bupivacaine is administered to provide an infraorbital nerve block. Local anaesthesia is also administered in the medial canthal region and medial eyelids. The nose is sprayed with 5% lidocaine with 0.5% phenylephrine solution. A ribbon gauze or 2cm neuroplagets soaked in 10% cocaine solution diluted with 10 ml of water is applied anterior to the point of insertion of the middle turbinate, the axilla of the middle turbinate and 1cm area above it. If general anaesthesia is used, decongestion of the nasal mucosa is achieved by spraying 5% lidocaine with 0.5% phenylephrine solution and applying the cocaine soaked ribbon gauze or neuroplagets.

Surgery begins by assessing the nasal septum particularly for any significant deflection in the region of the axilla of middle turbinates, which may need to be corrected by septoplasty for adequate exposure. The point of insertion of the middle turbinates and the lateral nasal wall and maxillary line are important landmarks for identifying the lacrimal sac (fig3).

**Fig.3: Visualizing middle turbinate and the lacrimal sac area**

This area is identified and infiltrated with 2% xylocaine and 1:200 000 adrenaline. We prefer a 0 degree scope but a 30 degree scope may be used. A flap is raised 5mm posterior and 8-10 mm above the axilla of the middle turbinate, the incision is brought 10 mm anterior to the axilla on to the frontal process of the maxilla. The incision is then turned vertically downwards and backwards towards the insertion of the uncinate under the middle turbinate (fig 4).

**Fig.4: Designing the flap.**

While raising the flap one should be careful over the junction of the frontal process of the maxilla with the thin lacrimal bone. To expose the lacrimal sac the bony lacrimal fossa needs to be uncovered. The identification of lacrimal fossa can be enhanced by transillumination(Fig 5). The Rosen knife (from ear instruments) is used to fracture the thin lacrimal bone (Fig 6).

**Fig.5: Illuminating lacrimal fossa**  **Fig.6: Fracturing the lacrimal bone**
The free frontal process of the maxilla is removed by the Higek punch. The rest of the thick bone is removed by powered endoscopic microdebrider with a rough diamond 2.5 mm DCR bur (Fig 7). Care should be taken not to damage the sac. As the posterior superior bone is removed the mucosa from the agger nasi cell is encountered. The inferior or superior punctum is dilated as the Bowmans lacrimal probe is passed and the tip of the probe is visualised with the endoscope, tenting the lateral wall of the lacrimal sac.

Fig.7: Bone removal by diamond burr

The lacrimal sac is then incised vertically for the whole length by using the lacrimal spear knife (Fig 8). The marsupialisation of the lacrimal sac is achieved by reflecting the mucosa of the lacrimal sac on the lateral nasal wall. The silastic O'Donaghue tubes are passed through the upper and lower canaliculus (Fig 9&10).

Fig.8: Marsupialisation of the sac

Fig.9: Insertion of the O'Donaghue tubes

Fig.10: Insertion of the O'Donaghue tubes

We use the Diode laser to open the canaliculi if required, before inserting the O'Donaghue Tubes. The tubes are then tied in the nasal vestibule in such away to allow the appropriate length and tension of the silicon tubing to loop on the puncta and the medial canthus (Fig11). A neuroplaget soaked in mitomycin C is applied to the operated area in the nose. The flap is then incised to allow it to wrap around the O'Donaghue tube (fig 12) and held in place by rapid rhino packing (fig 13). O’Donaghue tubing are removed after 8-10 weeks.

Fig.11: O'Donaghue tubes in the Puncta

Fig.12: Flap draped around O'Donaghue tubes

Fig.13: Rapid rhino pack on the flap

Results

A successful outcome is defined as a patient who is asymptomatic and has a healed patent lacrimal ostium with a free

http://endoscopicsinussurgery.co.uk/chaptereleven.html
flow of fluorescence from conjunctiva to the nose (5). The success is influenced by the anatomical versus the functional block. Wormald and Tsirbas noted a success of 97% in patients who has anatomical obstruction but only 84% in patients who had functional outflow impairment. The reported outcome of endoscopic DCR is summarised. Our results are comparable with an overall success of 84% with one year follow up (Table 1).

<table>
<thead>
<tr>
<th>Author</th>
<th>Number</th>
<th>Success Rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tripathi et al</td>
<td>46</td>
<td>89%</td>
<td>Laser assisted</td>
</tr>
<tr>
<td>Tsirbas Wormold</td>
<td>44</td>
<td>89%</td>
<td>Lacrimal and nasal mucosal flap</td>
</tr>
<tr>
<td>Massegar et al</td>
<td>96</td>
<td>93%</td>
<td>Hammer, chisel, mucosal flap</td>
</tr>
<tr>
<td>Javate, Pamintuan</td>
<td>117</td>
<td>98%</td>
<td>Radiofrequency, double stent, mitomycin C</td>
</tr>
<tr>
<td>Mian et al</td>
<td>62</td>
<td>84%</td>
<td>Mucosal flaps, mitomycin C</td>
</tr>
</tbody>
</table>

Table 1: Result of endoscopic DCR

Our recent data shows that result have improved over previous years due to ‘the learning curve’ and gained experiences.

Complication

In our series the most common complications we have encountered are infection (17%), followed by displaced tube (7%) (due to internal migration), granuloma and nose bleed.

References