The Egyptian Journal of Hospital Medicine (January 2022) Vol. 86, Page 781-787

Study of Nasofrontal Beak Identification as a Useful Landmark in Endoscopic Frontal Sinus Surgery

Magdy Mohamed Abdel Fattah, Ismael Seddik El Nashar,
Abdel Rahman Abdel Aziz Mohammed, Mohamed Mohamed Rabea
Department of Otorhinolaryngology, Faculty of Medicine, Zagazig University, Egypt.
***Corresponding author:** Abdel Rahman Abdel Aziz Mohammed, **Email:** azaz81154@gmail.com

ABSTRACT
Background: The nasal process of the frontal bone creates a bony thickening in the midline known as the nasofrontal beak (NFB). Surgery on the frontal sinuses can be safer when the NFB is used as a marker. **Objective:** To assess if identification of the nasofrontal beak during endoscopic frontal sinus surgery will add benefit to the identification of fontal sinus drainage pathway. **Patients and Methods:** From July 2020 to July 2021, At Zagazig University Hospitals, Otorhinolaryngology Department; trial included twelve patients with chronic frontal sinusitis who had been refractory to medical treatment for at least twelve weeks. All patients were scheduled for functional endoscopic sinus surgery. **Results:** The mean of distance from superior border of nasal beak to skull base in the right (Rt) side was 4.8 ± 2.9 and in the left (Lt) side was 5.4 ± 3.1. In terms of difficulty and distance, there was a significant negative association between the two variables; meaning that increasing distance would make the surgery easier. No recurrence of symptoms in Rt. side while in Lt. side recurrence occurs in only one case. Restenosis of frontal ostium didn't occur in any case in Rt side or Lt side. No nasal adhesions in Rt side, but occurred in Lt side in only one case **Conclusion**: The frontonasal beak is one of these fixed anatomical bony landmarks as frontal sinus ostium is located at the anterior edge of the anterior recess. Preoperative imaging can anticipate the difficulties of frontal recess surgery by identifying it.
Keywords: Endoscopic Frontal Sinus Surgery, Nasofrontal Beak.

INTRODUCTION
Chronic sinusitis that does not respond to medical treatment can be treated with endoscopic sinus surgery (ESS) [(1)]. Anatomical knowledge has improved thanks to the widespread use of the endoscopic sinus surgery. In spite of this, the surgeon is still confused by the frontal recess of the nose [(2)]. As a result of CT scans, surgeons have been able to better understand the anatomy of previously unknown locations such the middle meatal complex and the frontal recess [(3)].

Frontal sinus disease may necessitate frontal sinus surgery in which a coronal CT scan of the frontal sinus architecture is used to determine the best course of action. There are several anatomical variances in this region, and the surgeon must be able to translate the two-dimensional CT data into a three-dimensional anatomical picture in order to complete the dissection safely [(4)]. Sagittal reconstructions have been described in several studies as a tool for determining the relationship and morphology of the frontal recess and the frontal sinus ostium [(5)].

Nasofrontal beaks (NFB) are the midline bone thickenings created by the nasal process in frontal bone and are thought to represent an anterior boundary of the frontal sinus and frontal recess, respectively. The term "beak" refers to the posterior part of the nasal process of the frontal bone, which can produce a restriction of the frontal sinus ostium and outflow tract**.** Because the frontal sinus drains inferiorly into the frontal recess, the narrowest aperture between the NFB and the skull base is known as the internal frontal sinus ostium [(6)].

Intuitively, the NFB, which is the frontal bone's midline anterior thickening, should be located forward of the posterior table of the frontal sinus, the bone that sits directly above the olfactory fossa (OF). In theory, however, variations in the pneumatization of the frontal sinuses and their outflow tracts or in the growth of the NFB might lead to scenarios in which parts of the NFB either approximate or lie posterior to the anteriorly projected olfactory fossa [(6)]. As seen by parasagittal CT, frontal beak lies posteriorly a protrusion of lower part of anterior table of frontal sinus [(7)].

It was the goal of this study to evaluate whether or not the NFB can be used as a safe landmark to avoid skull base injury while doing frontal sinus surgery.

PATIENTS AND METHODS
This clinical trial took place from July 2020 to July 2021 at Zagazig University Hospitals' Otorhinolaryngology Department in Egypt. This research included twelve patients with chronic frontal sinusitis resistant to medical treatment for a period not less than twelve weeks.

Ethical considerations:
When all participants completed informed written consent and submitted them to the Research Ethics Committee at Zagazig University, the study was permitted (ZU-IRB#6889). Ethics guidelines for human experimentation were adhered to in line with the Helsinki Declaration of the World Medical Association.

Inclusion Criteria: There was no response to medical treatment in any of the patients who underwent a CT scan and needed further treatment for persistent sinusitis lasting more than three months. Surgery for the sinuses by use of endoscopic means patient must be fit for surgery, and aged 20-60 years old

Exclusion Criteria: Chronic sinusitis patients who improved after receiving medical therapy, patients who

Received: 11/10/2021
Accepted: 18/11/2021

refused to participate in the ESS, osteomyelitis and malignancies infiltrate the bones of patients, patients who were not fit for surgery, patients whose condition would require external frontal surgery, and revision cases.

All patients were subjected to the following:

A) Pretreatment evaluation:

1) Complete medical history including **nasal symptoms:** History about two main complaints (nasal obstruction and nasal discharge) and other nasal symptoms, (sneezing, post-nasal drip, headache and nasal itching, facial pain). The patient was diagnosed with chronic rhinosinusitis (CRS) for patients with two or more sinonasal symptoms (nasal blockage, anterior or posterior nasal discharge, headache or face aches, and/or anomalies of smell) and positive radiological results.
2) Nasal examination: **Nasal decongestion:** So that the nose could be examined more closely and the mucosa's response to decongestion might be observed, **Nasal endoscopy:** Diagnostic nasal endoscopy was done using (0° and 30° angle 4-mm Hopkin rods)
3) **Radiological evaluation** in the form of computed tomographic (CT) scanning was performed with 1 mm cuts. Plain CT scan paranasal sinuses, axial and coronal cuts with sagittal reconstruction bone window without contrast was routine for each patient. Detailed examination of the frontal sinus outflow tract was studied in each case. The nasofrontal beak was identified in the sagittal cuts. Measurements were taken from the most prominent point of the nasal beak to the skull base posteriorly at the point of inclination of the vertical and horizontal portions that was taken as an indicator of the frontal sinus ostium diameter. Also, the vertical length (height) of the beak was measured (Figure 1).

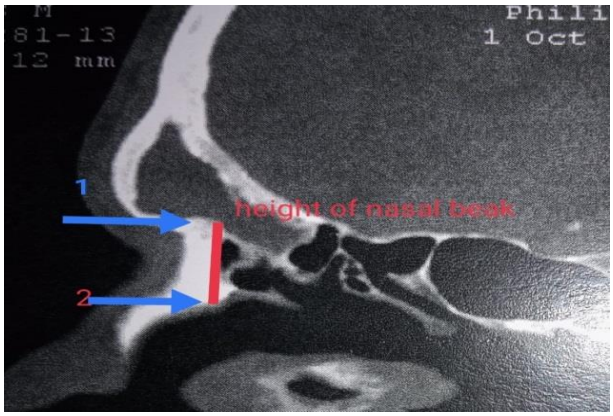

Figure (1): Height of nasal beak.

We also measured the R/S lines (R-line from the posterior border of nasal beak and S-line from the inclination of skull base) using the sagittal reconstruction. When drawing the first line, known as the reference or R-line, the vertical axis of the frontal process at the level of maxilla/lacrimal bone was standardized and drawn along the R-line; this had to do with the frontal beak's posterior projection. On the basis of the patient, the second line (S-line), which was drawn at the level of the front skull base at the level of the frontal sinus ostium, was varied in position. It was drawn in the same direction as the R-line.

We refer to a "positive" frontal ostium grade if the R-line is in front of the S-line (FOG positive). When the S- and R-lines of a frontal sinus cross, it is designated as having a FOG neutral (0) grade. We would define this as having a negative frontal ostium grade if the R-line is later than the S-line (FOG negative). Negative grades of FOG are projected to be the most difficult for surgeons to perform surgically because of the difficulty of the procedure and the need for the right angled apparatus. Predictably, surgery on the FOG negative ostium will take the most time [(8)].

4) Preoperative preparation: Pre surgery treatment consisted of a topical steroid for all cases with chronic sinusitis with or without nasal polyposis and short course of oral steroids only for those cases of chronic sinusitis with nasal polyposis and antibiotics if there is infection.

5) Operative procedure:

All patients underwent functional endoscopic sinus surgery. The procedure was done under general anesthesia. The rational in this operation was to assess the value of frontal beak identification prior to frontal sinusotomy. After complete sphenoethmoidectomy (according to the extension of the pathology) care was given to the upper attachment of the uncinate process. Complete removal of the uncinate process was done and the frontal beak was identified. Sometimes, this required removal of part of axilla of middle turbinate. The frontal sinus drainage pathway was explored immediately posterior to the nasal beak with removal of cells until the frontal sinus ostium was seen. The degree of difficulty in visualizing and accessing the frontal sinus ostium was assessed and compared to the preoperative radiological findings.

We proposed a simple grading system to assess the degree of difficulty of endoscopic frontal sinusotomy regarding the ability to visualize and access the frontal sinus ostium: Easy (frontal ostium can be visualized by 0° endoscope. Difficult: Grade 1 (+) frontal ostium can be visualized by 30° endoscope. Grade 2 (++) frontal ostium can be visualized by 70° endoscope. Grade 3 (+++) case which require drilling.

6) Follow up after surgery: Follow up weekly for first month, and then monthly for first 3 months. During follow up visits care was taken to assure; crust removal, suction of stagnant secretions and breaking of any synechiae.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Numbers and percentages were used to represent qualitative data. Mean ± standard deviation (SD) and range were used to represent quantitative data. P value < 0.05 was considered significant.

RESULTS

The sociodemographic data of the patients and their CRS symptoms are shown in table 1.

Table (1): Sociodemographic data, CRS-symptom among patients

Item	No=12	%=100
Age (Years)	**Mean ± SD**: 28.5 ± 7.2 **Range**: 20-40	
Sex:		
• Males	8	66.6
• Females	4	33.3
Occupation:		
• Worker	2	16.7
• Librarian	2	16.7
• Student	6	50
• Worker at cement Factory	2	16.7
Special Habits:		
• Null	12	100
Past history:		
• Null	6	50
• Head trauma	2	16.7
• Allergic rhinitis	2	16.7
• Hepatitis C virus	2	16.7
Item	**N=12**	**%**
Nasal Obstructions	8	66.7
Facial Pain/Headache	10	83.3
Rhinorrhea	2	16.7
Hyposmia	2	16.7
Post nasal discharge	2	16.7

Measurements of nasal beak, and rating of difficulty by surgeon and R/S ratio are shown in table 2.

Table (2): Measurements of nasal beak, rating of difficulty by surgeon, and R/S ratio among studied group

Item	Mean ± SD	Range
Vertical length (height) of nasal beak in Rt. side	2.1 ± 0.19	1.83-2.35
Vertical length (height) of nasal beak in Lt. side	1.8 ± 0.26	1.52-2.3
Distance from sup. border of nasal beak to skull base in Rt. side	4.8 ± 2.9	1.3-8.16
Distance from superior border of nasal beak to skull base in Lt. side	5.4 ± 3.1	1.28-9.11
Variable	**N=12**	**%**
Rating of difficulty by surgeon in Rt. side:		
(1) Can be seen by 0 degree endoscope	2	16.7
(2) Can be seen by 30 degree endoscope	10	83.3
Rating of difficulty by surgeon in Lt. side:		
(1) can be seen by 0 degree endoscope	6	50
(2) can be seen by 30 degree endoscope	4	33.3
(3) can be seen by 70 degree endoscope	2	16.7
R/S ratio in Rt. side:		
Neutral	6	50
Negative (when R line posterior to S line)	2	16.7
Positive (when R line posterior to S line)	4	33.3
R/S ratio in Lt. side :		
Neutral	2	16.7
Negative	2	16.7
Positive	8	66.7

We found that preservation of middle turbinate in Rt. side occurred in all cases while in Lt. side preservation occurred in all cases except one. Anterior ethmoidal artery was identified in all cases either right or left **(Table 3).**

Table (3): Operative findings among studied group

Variable	N=12	%
Identification of Rt. anterior ethmoidal artery • Yes	12	100
Identification of Lt. anterior ethmoidal artery • Yes	12	100
Preservation of Rt. middle turbinate • Yes	12	100
Preservation of Lt. middle turbinate • Yes • No	11 1	91.7 8.3
Time for reaching Rt. frontal sinus (min) • Mean ± SD • Range	33 ± 5.1 25-40	
Time for reaching Lt. frontal sinus(min) • Mean ± SD • Range	26 ± 3.2 22-30	

There was no significant association between rating difficulty by surgeon and vertical length (height) of nasal beak in both sides **(Table 4).**

Table (4): Association between rating difficulty by surgeon and vertical length (height) of nasal beak among studied group in Rt. and Lt. sides

Variable	Rating difficulty by surgeon on Rt side		t-test	p-value
Vertical length (height) of nasal beak:	**(1) N=2**	**(2) N=10**		
• Mean ± SD • Range	1.85 ± 0 1.85-1.85	2 ± 0.19 1.83-2.35	-1.4	0.146

Variable	Rating difficulty by surgeon on Lt. Side			F	p-value
Vertical length(height) of **nasal beak :**	**(1) N=6**	**(2) N=4**	**(3) N=2**		
• Mean ± SD • Range	1.9 ± 0.3 1.68 – 2.3	1.7± 0.17 1.52-1.81	1.96 ± 0 1.96 -1.96	1.4	0.285

There was significant negative correlation between rating difficulty by surgeon in both sides and R/S ratio **(Table 5).**

Table (5): **Correlation rating difficulty by surgeon in RT. and Lt Sides and R/S ratio among studied group**

	Rating difficulty by surgeon in Rt. Side	
	R	**P**
R/S ratio in right side	-0.65	**0.046**
	Rating difficulty by surgeon in Lt. side	
R/S ratio in lt. side	**R**	**P**
	-0.71	**0.044**

R: Correlation coefficient.

There was significant association between distance from nasal peak to skull base in both Rt. and Lt. side and rating difficulty by surgeon among studied group, i.e. when the distance is small it indicates difficult and more challenging and when it is smaller it would be more difficult **(Table 6).**

Table (6): Association between distance from nasal beak to skull base in Rt. and Lt. sides and rating difficulty by surgeon among studied group

Variable	Rating difficulty by surgeon in Rt. side		t-test	p-value
Distance from nasal peak to skull base:	**(1) N=2**	**(2) N=10**		
• Mean ± SD • Range	1.3 ± 0 1.3 -1.3	5.4 ± 2.7 1.4-8.1	-4.8	**0.001* (S)**
Variable	**rating difficulty by surgeon in Lt. side**			**f**	**p-value**
Distance from nasal peak to skull base:	**(1) N=6**	**(2) N=4**	**(3) N=2**		
• Mean ± SD • Range	5.7 ± 3.4 1.28– 9.11	3± 1.6 1.45-6.58	7.07 ± 0 7.07 -7.07	0.685	**0.045**

Recurrence of symptoms occurred in one case in Lt. side only. Restenosis of frontal ostium didn't occur in any case in Rt. side or Lt. side. nasal Adhesions occurre in Lt. side in only one case **(Table 7).**

Table (7): Postoperative follow-up data among studied group

Variable	N=12	%
Recurrence of symptoms in Rt. side • No	12	100
Recurrence of symptoms in Lt. side • No • Yes	11 1	91.7 8.3
Frontal sinus ostium restenosis in Rt. side • No	12	100
Frontal sinus ostium restenosis in Lt. side • No	11	91.7
Nasal adhesions in Rt. side • No	12	100
Nasal adhesions in Lt. side • No • Yes	11 1	91.7 8.3

Figure 2 shows intraoperative endoscopic view of anterior ethmoidal artery, frontal sinus ostium, and R and S lines.

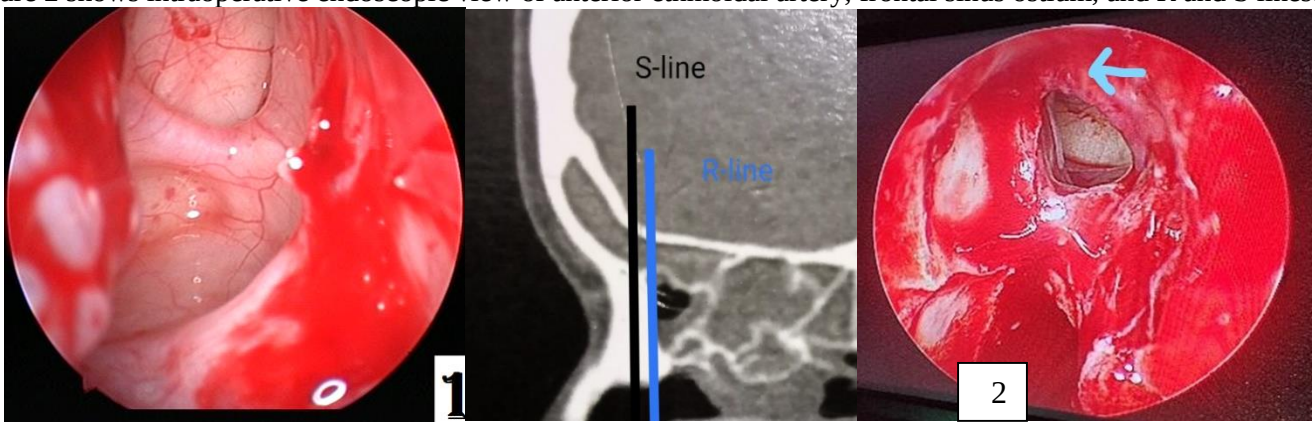

Figure (2): A 1. Intraoperative endoscopic view of preserved anterior ethmoidal artery. 2. Lt. intraoperative 30 degree endoscopic view of frontal sinus ostium with the arrow directed towards the nasal beak with preoperative sagittal cut showing R and S lines.

DISCUSSION

Rhinosinusitis (RS) encompasses a wide range of conditions that cause inflammation of the mucosa of the nose and mouth. One in every fifteen American people has RS, and the related direct and indirect healthcare expenses are enormous. Classic symptoms include nasal blockage, postnasal drip and face pain and/or pressure. Chronic rhinosinusitis, subacute rhinosinusitis, and acute rhinosinusitis are the three most commonly recognized subtypes of RS, according to the currently accepted classification scheme [(9)].

When it comes to frontal sinus surgery, endoscopy is far more difficult than other sinuses' procedures. Endoscopic surgery in the frontal sinus and recess region may be difficult because of the vast range of anatomical diversity present there, regardless of the presence of frontal cells. The internal frontal ostium's location, diameter, and position all contribute to this region's diversity [(10)].

In the present study, all the patients had bilateral CRS. 50 % of the patients had CRS with nasal polyps, while 50 % had CRS without nasal polyps. However, in the study of **Nakayama *et al.*** [(11)], 65% of patients were diagnosed with CRS with nasal polyps and 35% were diagnosed as CRS without nasal polyps.

As regard CRS- symptoms in the present study, 83.3% of the studied group have facial pain/headache and 66.7% had nasal obstructions. As regard CRS-related symptoms; half (50%) of them have cough and 33.3% had asthma. As regard co-morbidities; 33.3% of our studied group have allergy and 16.7% had history of trauma. In contrast, **Alsharif *et al.*** [(12)] revealed that thirty-two of 50 patients had a history of bronchial asthma; AERD (aspirin exacerbated respiratory disease) was reported in four cases. Thirty-three of the subjects had in total 76 previous sinus surgeries before inclusion into the study.

Frontal sinus recess (FSR) identification and exposure during endoscopy (ESS) might be difficult due to its varied morphology and limited entrance of frontal sinus ostium (FSO). The nasal cavity's frontal sinus connection can vary greatly. Frontal sinuses are most commonly formed by pits (furrows), which are formed in the FSR, according to cadaveric research. Frontal sinuses can be formed from up to a maximum of four pits, which are all capable of developing. The amount of furrows and the type of furrows that grow into sinuses vary widely across the population. Because of the wide range of possible outcomes, FSR surgery can be difficult [(10)].

In the current study, the vertical length (height) of the NFB was radiologically measured and compared to the degree of difficulty in visualizing and accessing the FSO during surgery. The mean of vertical length (height) of nasal beak in Rt side was 2.1 ± 0.19 while mean of vertical length (height) of nasal beak in Lt side was 1.8 ± 0.26. It was expected that with increasing height of the nasal beak, the degree of difficulty in visualizing and accessing FSO will increase. However, statistical analysis revealed no significant correlation.

In this study, the mean distance from the superior border of the nasal beak to the skull base posteriorly (which reflects the anteroposterior dimension of the FSO) was also measured, and compared to the degree of difficulty in visualizing and accessing the FSO. The mean of distance from superior border of nasal beak to skull base in the Rt side was 4.8 ± 2.9 and the mean of distance from superior border of nasal beak to skull base in the Lt side was 5.4 ± 3.1. There was a significant negative correlation between the distance and the degree of difficulty; meaning that increasing distance would make the surgery easier. These results are in agreement with the results of **Gheriani *et al.*** [(8)], who found frontal sinusotomy easier when this anteroposterior dimension of FSO is larger. Researchers discovered that the longer it takes to execute an endoscopic frontal sinusotomy with an anteriorly placed and narrower diameter frontal sinus ostium.

Furthermore, in the study of **Gheriani *et al.*** [(8)] the R/S relationship between two parallel lines, the Frontal Ostium Grade (FOG), was introduced. Lacrimal sac R is drawn along the vertical axis of maxilla's frontal process along the medial aspect of lacrimal sac R. S is drawn at the place where the anterior skull base deflects near the FSO. This makes it more difficult to get to the frontal sinus if the S-line is anterior to the R-line. These sinuses take longer to complete frontal sinusotomy than those with the R-line anterior to the S-line, according to the researchers. In the present study the RS grading was used and compared to the degree of difficulty in visualizing FSO and there was significant correlation in agreement with results of **Gheriani *et al.*** [(8)].

Assessing the degree of difficulty in doing frontal sinusotomy is mostly subjective. In a trial to objectively assess this difficulty, some authors as **Gheriani *et al.*** [(8)], used the operative time taken to do frontal sinusotomy as an indicator of the difficulty. Others like **Kołodziejczyk *et al.*** [(13)], used the angulation of the endoscope necessary to do the procedure and the dimensions of the frontal angle as an indicator of difficulty. In this study we proposed a grading of difficulty based on the angle of the endoscope needed to visualize the FSO and the need for drilling as indicators of difficulty of the anatomy of the FSO. We didn't use the operative time, though logic, as indicator as we think that the operative time needed for frontal sinusotomy depends on many variables as the pathology, the degree of bleeding and the types of cells obstructing the frontal sinus outflow tract. We think that after removal of the variable cells obstructing the frontal sinus outflow tract, the fixed bony anatomical landmarks will remain and the ability to visualize these landmarks are most important in determining the difficulty of frontal sinusotomy.

Hosemann *et al.* [(14)] described the impact on endonasal frontal sinus surgery that anatomical heterogeneity in the spina nasalis interna (the nasal

process of the frontal bone) can have because of the increased difficulty of endonasal frontal sinus surgery due to the greater anteroposterior spina nasalis, a drill may be required. Prior to endonasal frontal sinus surgery, sagittal CT reformat cuts should be used to evaluate this area.

Moreover, **Hilger *et al.* [(15)]** evaluated ten sagittal reconstructed thin CT cuts and documented the various changes of the angle between the frontal sinus and the ethmoid infundibulum, it appeared to be dependent on the frontal sinus' anterior projection and give an indicator of what angle is needed to view its frontal ostium, according to the authors. When the "front-nasal-angle" is smaller, a more angled endoscope is required to see the frontal sinus ostium.

As regard operative findings; preservation of middle turbinate in Rt. side occurred in all cases while in Lt. side preservation occurred in all cases except one. Anterior ethmoidal artery was identified in all cases either right or left. Mean and SD for the time needed for reaching frontal sinus in the Rt. side 33 ± 5.1 (min) and its range is 25-40 (min). Mean and SD for the time needed for reaching frontal sinus in the Lt. side 26 ± 3.2 (min) and its range is 22-30 (min).

Our results showed that no recurrence of symptoms in Rt. side while in Lt. side recurrence occurred in only one case. Restenosis of frontal ostium didn't occur in any case in Rt side or Lt. side. No nasal adhesions in Rt side, but occurred in Lt side in only one case.

CONCLUSION

In addition to the variable frontal cells interfering with the frontal sinus outflow tract, the fixed bony anatomical landmarks are of utmost importance in determining the difficulty of frontal sinus surgery. The frontonasal beak is one of these fixed anatomical bony landmarks as it represents the anterior boundary of the frontal recess and frontal sinus ostium. Its identification in imaging preoperatively can predict the expected difficulty in frontal recess surgery. Moreover, its identification and exposure during surgery is important as it represents the anterior limit of dissection in simple frontal sinus procedures and the hard bone to be removed in the more advanced ones.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Kaliner M, Osguthorpe J, Fireman P (1997):** Sinusitis bench to bedside. Current findings, future directions. J Allergy Clin Immunol., 99: 829-47.
2. **Stammberger H, Kennedy D, Bolger W (1995):** Paranasal sinuses: anatomic terminology and nomenclature. Ann Rhinol Otol Laryngol., 167: 7–16.
3. **Babbel R, Harnsberger H, Nelson B (1991):** Optimization of techniques in screening CT of the sinuses. Am J Neuroradio., 12:849–854.
4. **Kennedy D, Senior B (1997):** Endoscopic sinus surgery. A review. Otolaryngol Clin North Am., 30:313–330.
5. **Jacobs J, Lebowitz R, Sorin A (2001):** Preoperative sagittal CT evaluation of the frontal recess. Am J Rhinol., 14:33–37.
6. **Weber R, Draf S, Kratzsch B *et al.* (2001):** Modern concepts of frontal sinus surgery. Laryngoscope, 111:137–146.
7. **Wormald P, Ananda A, Nair S (2003):** Modified endoscopic Lothrop as a salvage for the failed osteoplastic flap with obliteration. Laryngoscope, 11: 1988–92.
8. **Gheriani H, Al-Salman R, Habib A *et al.* (2020):** Frontal ostium grade (FOG): A new computer tomography grading system for endoscopic frontal sinus surgery. Otolaryngology–Head and Neck Surgery, 163(3):611-617.
9. **Basharat U, Aiche M, Kim M *et al.* (2019):** Are rhinoviruses implicated in the pathogenesis of sinusitis and chronic rhinosinusitis exacerbations? A comprehensive review. In International Forum of Allergy & Rhinology, 9: 1159-1188.
10. **Kuhn D (2006):** Do cognitive changes accompany developments in the adolescent brain? Perspectives on Psychological Science, 1(1):59-67.
11. **Nakayama T, Asaka D, Kuboki A *et al.* (2018):** Impact of residual frontal recess cells on frontal sinusitis after endoscopic sinus surgery. European Archives of Oto-Rhino-Laryngology, 275(7): 1795-1801.
12. **Alsharif S, Jonstam K, Van Zele T *et al.* (2019):** Endoscopic sinus surgery for type-2 CRS wNP: an endotype-based retrospective study. The Laryngoscope, 129(6): 1286-1292.
13. **Kołodziejczyk P, Gotlib T, Niemczyk K (2021):** Frontal sngle: A new predictor of difficulty in endoscopic frontal sinus surgery—A preliminary computed tomography study. Ear, Nose & Throat Journal, 21: 1455613211003802. https://pubmed.ncbi.nlm.nih.gov/33829887/
14. **Hosemann W, Gross R, Goede U *et al.* (2001):** Clinical anatomy of the nasal process of the frontal bone (spina nasalis interna): Otolaryngol Head Neck Surg., 125(1):60-65.
15. **Hilger A, Ingels K, Joosten F (1999):** Sagittal computerized tomography reconstruction of the lateral nasal wall for functional endoscopic sinus surgery. Clin Otolaryngol Allied Sci., 24(6):527-530.