

**FRONTAL RECESS CELL IN FRONTAL SINUSITIS- A RADIOLOGICAL STUDY***Senthilnathan V<sup>1</sup>, Gnanavelraja C<sup>2</sup>, Alli Arimapamagan<sup>3</sup>, M. Rajajeyakumar<sup>4</sup>*<sup>1</sup>Associate Professor, Department of Radiology, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Trichy, Tamil Nadu.<sup>2</sup>Associate Professor, Department of Anatomy, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Trichy, Tamil Nadu.<sup>3</sup>Consultant Radiologist, Department of Radiology, Senthil Scans, Tanjavur, Tamil Nadu.<sup>4</sup>Assistant Professor, Department of Physiology, Trichy SRM Medical College Hospital and Research Centre, Irungalur, Trichy, Tamil Nadu.

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**ABSTRACT**

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**BACKGROUND**

Anatomy of the frontal recess is difficult to understand, understanding the anatomy of frontal recess and frontal sinus outflow tract is essential for the surgeon to perform nasosinus endoscopic surgery in case of frontal sinusitis to get a good post-operative result. Frontal recess anatomy can be best appreciated with the help of CT scan.

The aim of the present study is to find out the incidence of frontal recess cells in patients with frontal sinusitis.

**MATERIALS AND METHODS**

This retrospective study involved a total of 50 patients who were suffering from frontal sinusitis taken up for CT scan for paranasal sinuses. Frontal recess cells were identified according to Bent et al classification by two radiologists individually and analysed with appropriate statistical method.

**RESULTS**

Among the total of 100 sides of CT scan paranasal sinuses, frontal recess cell were found in 62%; among them, Type 1 frontal recess cells were found in 46 sides (46%), Type 2 frontal recess cells were found in 3 sides (3%), Type 3 frontal recess cells were found in 12 sides (12%), Type 4 frontal recess cells were found in 1 side (1%), frontal cells were absent in 38 sides (38%). The percentage of distribution of frontal recess cells was more on left side in all age group in both sexes.

**CONCLUSION**

Type 1 frontal recess cell is the most common type and Type 4 frontal recess cell is the least common type in CT scan of paranasal sinuses in patients with frontal sinusitis.

**KEYWORDS**

Frontal Recess Cell, Frontal Sinusitis, CT Scan.

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**BACKGROUND**

The anatomical variations in paranasal sinus may cause the improper drainage of para nasal sinuses which may increase the extent of sinus mucosal diseases causing sinusitis.<sup>1</sup> The ostiomeatal complex consist of anterior and posterior osteomeatal unit, in that anterior osteomeatal unit consist of ostium of maxillary sinus, ostia of anterior and middle ethmoidal air cells, frontonasal duct (frontal recess), ethmoidal infundibulum, and middle meatus whereas posterior osteomeatal unit consist of sphenoethmoidal recess and the superior meatus.<sup>2,3</sup> The complexity in the

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anatomy of the frontal recess and frontal sinus outflow tract needs proper anatomical knowledge about this area to perform nasosinus endoscopic surgery in case of frontal sinusitis to get a good post-operative result.<sup>4</sup> Frontal recess consist of many type of cells among that agar nasi cells and frontal recess cells alter the drainage of frontal recess causing frontal sinusitis needs special attention.<sup>5,6</sup> Understanding the anatomy of frontal recess is nowadays made easy with the use of CT scan with high level of accuracy and clarity. CT scan of paranasal sinuses gives the proper detail about presence of any anatomic abnormalities, location and severity of disease and exact location of obstruction. Better anatomical knowledge about the frontal recess with the help of CT scan, definitely prevent the unnecessary post-operative complications giving comfort post-operative result to the patient.

**Aim of the Study**

The aim of the present study is to evaluate the incidence of frontal recess cells in patients with frontal sinusitis.



## MATERIALS AND METHODS

This study was conducted in Trichy SRM Medical college hospital and research centre, Irungalur, Trichy, after getting the Institutional ethical committee clearance. Totally 100 sides of 50 patients who were suffering from frontal sinusitis diagnosed clinically and taken CT scan for paranasal sinuses were included in our study. Patients with previous nasal and paranasal sinus surgery, neoplastic diseases, history of nasal trauma and pregnant women were excluded from the study. Frontal sinusitis was confirmed when the sinus had mucosal thickening >3 mm on CT scan.

## Methodology

The images which were taken by Dual slice GE Hispeed CT Scanner with 2 to 3 mm thickness coronal images with scan time of 49.5 sec were analysed for the presence of frontal recess cells by two radiologists individually to prevent observer variation which may bias the study result.

The frontal recess cells were identified and classified according to the classification given by Bent et al.<sup>7</sup> (Figure 1 to 4)

- Type 1: Single frontal recess cell above the agar nasi.
- Type 2: Tier of air cells above agar projecting into the frontal recess.
- Type 3: Single massive air cell above agar expanding in superior direction.
- Type 4: Single isolated cell within frontal sinus. Difficult to visualize due to thin walls.

The distribution of frontal recess cells in patients with frontal sinusitis were measured according to age, sex and side and analysed by appropriate statistical method using SPSS 21 package.

## RESULTS

The study group comprises of 38 men and 12 women (age 15 to 60 years).when we analysed the CT scan of both sides (Totally 100 sides) frontal recess cell were found in 62% among that, Type 1 frontal recess cell were found in 46 sides (46%), Type 2 frontal recess cell were found in 3 sides(3%), Type 3 frontal recess cell were found in 12 sides(12%), Type 4 frontal recess cell were found in 1 side (1%), frontal cell were absent in 38 sides (38%) (Ref. Fig. 5). The distribution of frontal recess cell in relation to age, sex and side is shown in table 1 to 4.

Age (in yrs.)	Type 1 Frontal Recess Cell No. (%) of Sides	Type 2 Frontal Recess Cell No. (%) of Sides	Type 3 Frontal Recess Cell No. (%) of Sides	Type 4 Frontal Recess Cell No. (%) of Sides	Absence of Frontal Recess Cell No. (%) of Sides
15-30	5	---	2	---	4
31-45	20	1	3	1	18
46-60	7	1	2	---	12

**Table 1. The Percentage of Distribution of Frontal Recess Cell in Frontal Sinusitis in Relation to Age in Men**

Age (in yrs.)	Type 1 Frontal Recess Cell No. (%) of Sides	Type 2 Frontal Recess Cell No. (%) of Sides	Type 3 Frontal Recess Cell No. (%) of Sides	Type 4 Frontal Recess Cell No. (%) of Sides	Absence of Frontal Recess Cell No. (%) of Sides
15-30	3	---	1	---	1
31-45	8	1	2	---	2
46-60	3	---	2	---	1

**Table 2. The Percentage of Distribution of Frontal Recess Cell in Frontal Sinusitis in Relation to Age in Women**

Age (in yrs.)	Type 1 Frontal Recess Cell		Type 2 Frontal Recess Cell		Type 3 Frontal Recess Cell		Type 4 Frontal Recess Cell	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
15-30	2	3	---	---	---	2	---	---
31-45	7	13	---	1	1	2	1	---
46-60	3	4	1	---	1	1	---	---

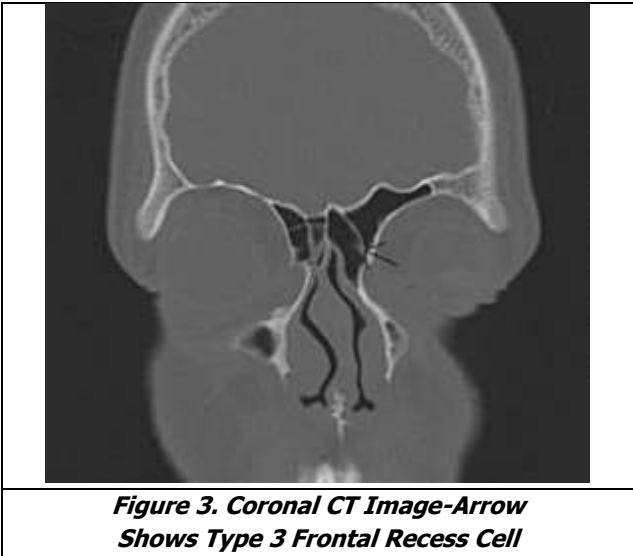
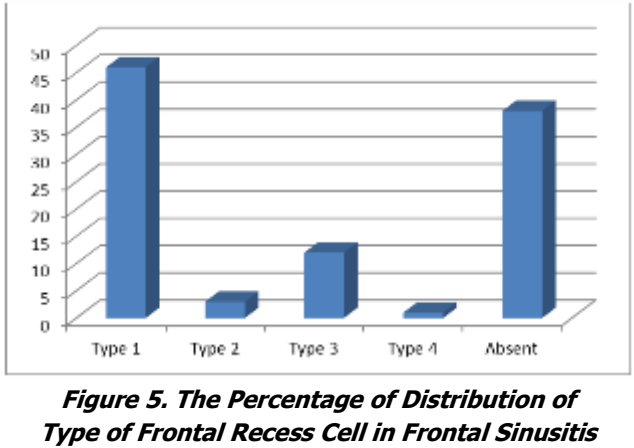
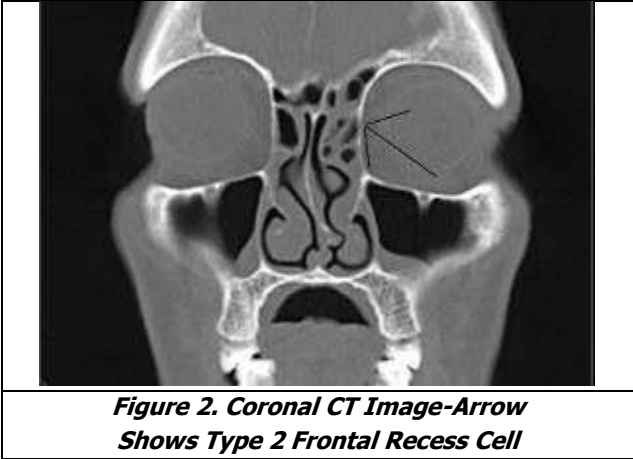
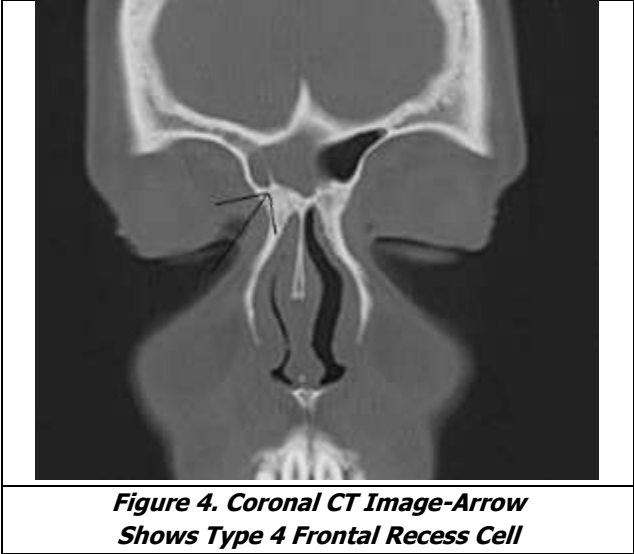
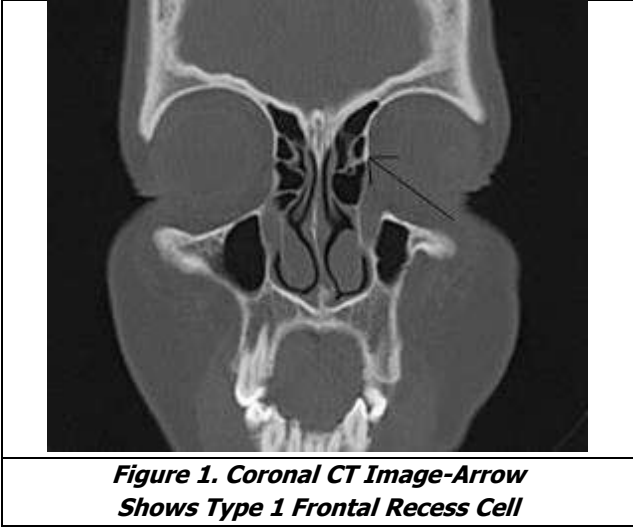
**Table 3. Type of Frontal Recess Cell in Frontal Sinusitis in Relation to Side in Men**

Age (in yrs.)	Type 1 Frontal Recess Cell		Type 2 Frontal Recess Cell		Type 3 Frontal Recess Cell		Type 4 Frontal Recess Cell	
	Rt	Lt	Rt	Lt	Rt	Lt	Rt	Lt
15-30	1	2	---	---	---	1	---	---
31-45	2	6	---	1	1	1	---	---
46-60	1	2	---	---	1	1	---	---

**Table 4. Type of Frontal Recess Cell in Frontal Sinusitis in Relation to Side in Women**

Type of Frontal Recess Cell	Present Study	Previous Studies				
		Meayer et al	Lee et al	Del Gaudio et al	Langille et al	Sagar et al
Type 1	46	14.9	37	18.4	26	44
Type 2	3	3.1	19	2	6.4	8
Type 3	12	1.7	8	6.1	2.1	48
Type 4	1	2.1	0	3.1	0	2

**Table 5. The Percentage of Distribution of Frontal Recess Cell in Frontal Sinusitis**



**DISCUSSION**

The frontal recess is inverted funnel shape space in which apex is formed by frontal sinus ostium. The nasal part of frontal sinus, frontal infundibulum or nasofrontal duct also consider as frontal recess. The frontal recess is bounded medially by middle turbinate, laterally by lamina papyracea, superiorly by skull base, inferiorly attachment of uncinate process, anteriorly by agar nasi cell and posteriorly by bulla ethmoidalis. This frontal recess was first described by Killian in 1903 later it was detailed by Van Alyea. The frontal recess form the one of the component of the drainage pathway of frontal sinus, frontal recess consist of agar nasi cell and frontal recess cell which may alter the drainage pathway of frontal sinus leading to frontal sinusitis. The proper anatomical knowledge about this frontal recess cell is necessary to get good post-operative result while doing endoscopic sinus surgery.<sup>4,8</sup> In our study frontal recess cell were found in 62%, and absent in 38%. When we analyse

the percentage of distribution of frontal recess cell in relation to age, sex (Ref Table 1 to 2) Type 1 frontal recess cell were present in 32 sides (%) in men and 14 sides (%) in women among that percentage of distribution of Type 1 frontal recess cell was present in the age group of 31 yrs. to 45 yrs. in both sexes, Type 2 frontal recess cell were present in 2 sides (%) in men and 1 sides (%) in women, Type 3 frontal recess cell were present in 7 sides (%) in men and 5 sides (%) in women among that percentage of distribution of Type 3 frontal recess cell were almost equally present in all age group in both sexes, Type 4 frontal recess cell were present in 1 side (%) in men that also in the age group of 31 yrs. to 45 yrs. in men, we couldn't find Type 4 frontal recess cell in women in all age group. When we analyse the distribution of frontal recess cell in relation to side (Ref Table 3 to 4), Percentage of distribution of Type 1 frontal recess cell was more on left side in both sexes, Percentage of distribution of Type 2 frontal recess cell was equally distributed (1%) in both side in men but only present on left side (1%) in women, Percentage of distribution of Type 3 frontal recess cell was more on left side in both sexes, Percentage of distribution of Type 4 frontal recess cell was present in one side (1%) that also in right side. All type of frontal recess cell was distributed mostly on left side except Type 4 frontal recess cell which was present on right side. In total Type 1 frontal recess cell were found in 46 sides (46%), Type 2 frontal recess cell were found in 3 sides (3%), Type 3 frontal recess cell were found in 12 sides (12%), Type 4 frontal recess cell were found in 1 side (1%), frontal cell were absent in 38 sides (38%), when we compare our study result with previous study conducted by Meyer et al<sup>9</sup> found Type 1 frontal recess cell in 14.9%, Type 2 frontal recess cell in 3.1%, Type 3 frontal recess cell in 1.7%, Type 4 frontal recess cell in 2.1%. A study conducted by Lee et al<sup>10</sup> found Type 1 frontal recess cell in 37%, Type 2 frontal recess cell in 19%, Type 3 frontal recess cell in 8%, Type 4 frontal recess cell in 0%. In Del Gaudio et al<sup>11</sup> study Type 1 frontal recess cell was found in 18.4%, Type 2 frontal recess cell were found in 2%, Type 3 frontal recess cell were found in 6.1%, Type 4 frontal recess cell were found in 3.1%. In similar study conducted by Langille et al<sup>12</sup> Type 1 frontal recess cell were found in 26%, Type 2 frontal recess cell were found in 6.4%, Type 3 frontal recess cell were found in 2.1%, Type 4 frontal recess cell were found in 0%. In a study conducted by Sagar et al<sup>5</sup> Type 1 frontal recess cells were found in 44%, type 2 in 8%, type 3 in 48% and type 4 in 2% of the cases. In our study Type 1 frontal recess cell was the most common type and Type 3 frontal recess cell was the next common type, which is similar to previous study conducted by Del Gaudio et al,<sup>11</sup> Sagar et al.<sup>5</sup> But our study results were contradictory to meyer et al,<sup>9</sup> lee et al,<sup>10</sup> Langille et al,<sup>12</sup> they found Type 1 frontal recess cell was the most common type and Type 2 frontal recess cell was the next common type. The least common frontal recess cell found was Type 4, which is similar to the study results conducted by, Lee et al,<sup>10</sup> Langille et al<sup>12</sup> Sagar et al<sup>5</sup>(Ref Table 5).

## CONCLUSION

The blockage in the frontal sinus outflow tract is the important cause for the development of frontal sinusitis. The frontal recess cell may alter the drainage path way of frontal sinus leading to frontal sinus mucosal disease-causing frontal sinusitis. Anatomical knowledge about frontal recess cells is the basis for the removal of disease in the frontal sinus drainage pathway which is nowadays best appreciated by CT scan. Knowing the anatomy of frontal recess and various types of cells present, is very essential for the surgeon to prevent post-operative complications while doing functional endoscopic sinus surgery in frontal recess area. From our study, we conclude that Type 1 frontal recess cell is the most common type and Type 4 frontal recess cell is the least common type in our study which is appreciated in previous study also. The percentage of distribution of frontal recess cell was more on left side in all age groups in both sexes. Frontal recess cells were absent in 38% of study population. Development of frontal sinusitis even in the absence of frontal recess cell giving the background for future study to find the association of frontal recess cells with frontal sinusitis in large population.

## REFERENCES

- [1] Mendiratta V, Baisakhiya N, Singh D, et al. Sinonasal anatomical variants: CT and endoscopy study and its correlation with extent of disease. *Indian J Otolaryngol Head Neck Surg* 2016;68(3):352-358.
- [2] Mafee MF, Chow JM, Meyers R. Functional endoscopic sinus surgery: anatomy, CT screening, indications, and complications. *AJR Am J Roentgenol* 1993;160(4):735-744.
- [3] Nayak S. Radiologic anatomy of the paranasal sinuses. *Seminars in Ultrasound, CT and MRI* 1999;20(6):354-378.
- [4] Stammberger H, Kennedy DW, Bolger WE, et al. Paranasal sinuses: anatomic terminology and nomenclature. *Ann Otol Rhinol Laryngol Suppl* 1995;167:7-16.
- [5] Sagar GR, Jha BC, Meghanadh KR. A study of anatomy of frontal recess in patients suffering from chronic frontal sinus disease. *Indian J Otolaryngol Head Neck Surg* 2013;65(Suppl 2):435-439.
- [6] Eweiss AZ, Khalil HS. The prevalence of frontal cells and their relation to frontal sinusitis: A radiological study of the frontal recess area. *ISRN Otolaryngology* 2013;2013:1-4.
- [7] Bent JP, Cuilty-Siller C, Kuhn FA. The frontal cell as a cause of frontal sinus obstruction. *American Journal of Rhinology & Allergy* 1994;8:185-191.
- [8] Dua K, Chopra H, Khurana AS, et al. CT scan variations in chronic sinusitis. *Indian J Radiol Imaging* 2005;15(3):315-320.
- [9] Meyer TK, Kocak M, Smith MM, et al. Coronal computed tomography analysis of frontal cells. *Am J Rhinol* 2003;17(3):163-168.

- [10] Lee WT, Kuhn FA. 3D computed tomographic analysis of frontal recess anatomy in patients without frontal sinusitis. *Otolaryngol Head Neck Surg* 2004;131(3):164-173.
- [11] DelGaudio JM, Hudgins PA, Venkatraman G, et al. Multiplanar computed tomographic analysis of frontal recess cells: effect on frontal isthmus size and frontal sinusitis. *Arch Otolaryngol Head Neck Surg* 2005;131(3):230-235.
- [12] Langille M, Walters E, Dziegielewska PT, et al. Frontal sinus cells: identification, prevalence, and association with frontal sinus mucosal thickening. *Am J Rhinol Allergy* 2012;26(3):e107-e110.