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Morphometric Sexual Dimorphism of Frontal Air Sinus: ACT Study

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Abstract:
Introduction:*The revolutionary changes in the surgical treatment of sinusitis in recent years, particularly in endonasal endoscopic surgery require the clinician to have precise knowledge of nasal sinus anatomy.*
Material and Methods:*This study was undertaken on head CTs PNS of 119 patients (67 males & 52 females) in the age group of 12 to 70 years were included in this retrospective study in terms of Antero-posterior diameter, Height,Width &Volume.*
Result:*Different parameters in male and female taken on right and left side, the differences among them are not significant.But, values of different parameters in male are towards higher side compared to females. AP diameter, Height & Volume are towards higher side on right side compared to left; while Width showing opposite i.e. higher values on left side.*
Conclusions:*The sound knowledge of frontal sinus morphometry and variability is very useful to plan surgical approach to frontal sinus and forensic identification of human which applied in medico-legal issues.*
Keywords: *Frontal Sinus,AP diameter,Height, Width,Volume, Sexual Dimorphism*

I. Introduction

There exists many historical references to the paranasal sinuses. The earliest such reference can be dated back to the works of Galen, who described the presence of the ethmoid air cells. Later descriptions of the maxillary sinuses by Leonardo da Vinci (1489), the sphenoid sinuses by Giacomo Berengario da Carpi (1521), and the frontal sinuses by Coiter (16^{th} century) introduced early anatomists and scholars to the presence of these craniofacial air cells.[1]

The frontal sinus is funnel-shaped cavity, unique to individual and separated by septum. [2]

The frontal sinus is often thought as a more "symptomatic sinus" because of the difficulties encountered in frontal sinusitis and maintaining a patent frontal sinus ostium in patients with; difficult to treat frontal rhinosinusitis. [3]The revolutionary changes in the surgical treatment of sinusitis in recent years, particularly in endonasal endoscopic surgery require the clinician to have precise knowledge of nasal sinus anatomy.The aim of this study was to know the morphometric dimensions being useful tool to plan surgical approach to frontal sinus and useful mean of forensic identification of human & can also be applied in medico-legal issues.

II. Material & Methods

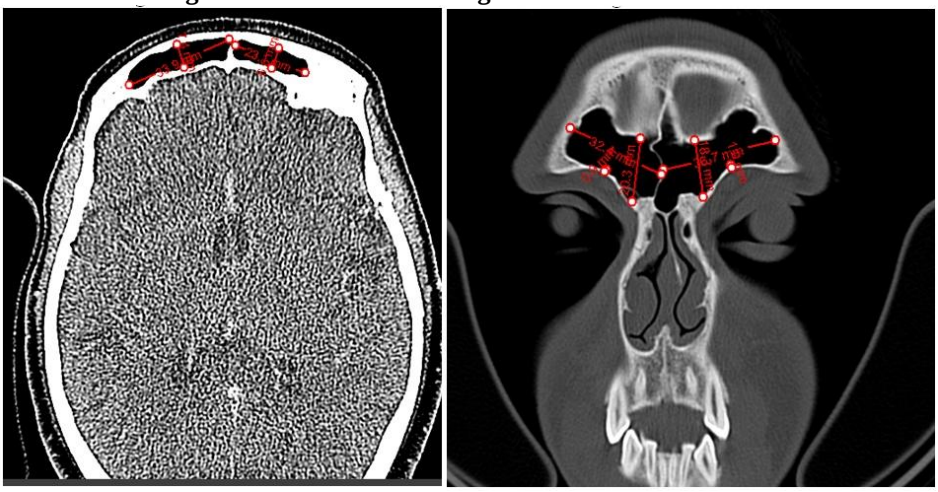
With prior approval of the ethical committee, study was carried out over 119 normal Head CTs PNS (67 males & 52 females) in the age group of 12 to 70 yrs. with Dual Slice Siemens Volume Access (SOMATOM) CT Scan Machine**.** So, different Coronal and Axial slices with 0.6 mm, 1.25 mm and 4 mm thickness were collected and further analysis was done with help of computer analogue attached with CT scan machine.Antero-posterior diameter, Width and Height were taken at their maximum measurements as shown in **Figure No. 1&2.** We got Antero-posterior diameter, Width in axial section and Height, Width in coronal section.

If, only axial sections were taken in any patient then,

Height = ∑ thickness of all axial sections in which frontal sinus was visible

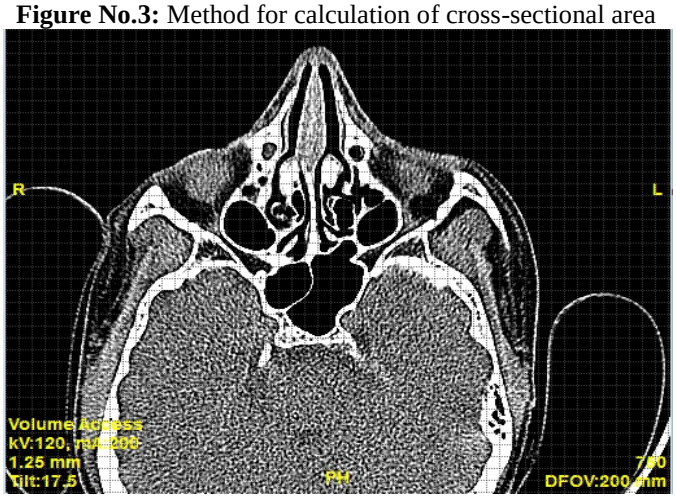
And when only coronal sections were taken in any patient then,
Antero-posterior diameter = ∑ thickness of all coronal sections in which frontal sinus was visible

Figure No.1: Axial section**Figure No.2.** Coronal section



Formula for Volume of Frontal sinus is,
According to Trapezoidal rule by **Ikeda A, et al.[4] (1998), Fernandez SJM, et al.[5] (2000)**
V = [(A1 + A2) h/2] + [(A2 + A3) h/2] + [(A3 + A4) h/2] +……
Where,
V - Volume of frontal sinus.
A1, A2, A3, A4, ... - Cross-sectional areas of successive CT sections.
h - Thickness of slice.

Figure No.3: Method for calculation of cross-sectional area



Statistical Analysis
Continuous and categorical variables were presented as (Mean ± Standard Deviation).A paired t-test was applied and p-value yielded. The statistical analysis was done by using Fisher's Exact Test.

III. Observations And Results

The results of the reliability analysis of CT, as a method for the measurement of different dimensions of frontal sinuses are taken gender-wise and side-wise in tabulated form.

1) AP DIAMETER

Table No. 1: Gender & Side wise values of AP diameter

Sex	AP diameter (Right) (Mean ± SD) in mm	AP diameter (Left) (Mean ± SD) in mm
Male	14.38 ± 6.61	13.9 ± 6.52

Female	12.89 ± 6.50	12.15 ± 5.07
Significance	Not significant	Not significant

2) HEIGHT

Table No. 2: Gender & Side wise values of Height

Sex	**Height (Right) (Mean ± SD) in mm**	**Height (Left) (Mean ± SD) in mm**
Male	15.63 ± 6.92	15.83 ± 7.38
Female	13.74 ± 6.18	13.35 ± 6.85
Significance	Not significant	Not significant

3) WIDTH

Table No. 3: Gender & Side wise values of Width

Sex	**Width (Right) (Mean ± SD) in mm**	**Width (Left) (Mean ± SD) in mm**
Male	21.58 ± 8.76	23.28 ± 9.88
Female	20.54 ± 9.17	21.34 ± 9.27
Significance	Not significant	Not significant

4) **VOLUME**

Table No. 4: Gender & Side wise values of Volume

Sex	**Volume (Right) (Mean ± SD) in cm^3**	**Volume (Left) (Mean ± SD) in cm^3**
Male	3.21 ± 1.67	3.06 ± 1.48
Female	3.08 ± 1.24	2.83 ± 1.42
Significance	Not significant	Not significant

From Table No. 1,2,3&4 it is observed that, different parameters in male and female taken on right and left side, the differences among them are not significant.But, values of different parameters in male are towards higher side compared to females. AP diameter, Height & Volume are towards higher side on right side compared to left; while Width showing opposite i.e. higher values on left side.

IV. Discussion

Technological advances in this imaging modalities have provided more precise differential diagnosis and greater detail about the anatomic extent of the diseases of PNS. These provide sufficient information for diagnosis and surgical planning in the PNS diseases.[6]There are considerable variations in the shape, capacity and symmetry of the frontal sinuses. The environmental & genetic factors, ethnicity, craniofacial configuration and the thickness of frontal bone etc. can play a major role in these differences.[7,8,9]In present study parameters such as Antero-posterior diameter, Height, Width, Volume etc. were analysed by applying the multivariate analysis. These various parameters were compared with the earlier studies. Our study, correlates with the study of **Tatlisumak E, et al.[10] (2008) & Mathew KL, et al.[11] (2010)** in case of AP diameter, but not in Height & Width where there is significant male - female difference, that too male having higher values.In the present study, Volume of frontal sinus when compared between male and female, the readings of males are towards higher side as compared to females but, it is not significant. This correlates with **Ponde JM, et al.[12] (2008).** Whereas, **Sacide K, et al.[13] (2005)** got significant relation; that too more in males as compared to females. This variation could be due to difference in the range of age group.

V. Conclusion

Thus sound knowledge of frontal sinus morphometry and variability helps surgeon in carrying out various surgical procedures viz. FESS, cranioplasty and sinus surgery. The morphometric ante-mortem data of particular patient can also be stored for post-mortem identification of the same individual just like record of fingerprint.Finally, we had made an attempt to study mean differences of different sex and side however, no significant difference when compared gender and side wise. But, male and right sided frontal sinuses shows values towards higher side compared to females and left sided frontal sinuses; Except Width, which shows higher values on left side.

❖ **List Of Abbreviations:**

- AP Diameter – Antero-Posterior Diameter.
- PNS – Para Nasal Sinuses.
- M – Mean
- SD – Standard Deviation

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