Assessment of depth of olfactory fossa in pre-functional endoscopic sinus surgery computed tomography scan of paranasal sinuses

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Abstract

Aims: Computed tomography, measure variations in the depth of olfactory fossa (OF) and characterise India's population according to the Keros categorization (CT).

Materials and Methods: This study was conducted in our institution over a period of 1 year (June 2018 to June 2019). Patients >16 years of age undergoing CT scan of paranasal sinuses (PNS) were included. A total of 1200 patients' PNS CT scan studies were evaluated. The vertical height of the lateral lamella was used to determine the depth of OF. Independent samples t test and Chi Square test were used to examine the results by gender and laterality.

Results: OF had a mean depth of 5.16 ± 1.59 mm. The mean depth of OF between males and females was statistically significant, but not between right and left sides. Keros type I was discovered on 210 sides (17.5%), type II on 895 (74.6%), and type III on 95 sides (7.9 percent).

Conclusion: Even while the prevalence of the harmful type III OF is modest, it is considerable, particularly among men and on the right side. To avoid iatrogenic consequences, a preoperative assessment of depth is required.

Keyword: Functional endoscopic sinus surgery; Keros; olfactory fossa

Introduction

Functional endoscopic sinus surgery (FESS) has been a popular therapeutic option for illnesses of the nose and paranasal sinuses in recent years (PNS). Even while the incidence of related issues is significantly lower in FESS as compared to traditional techniques, it is not without risk.

Multiplanar imaging, particularly coronal reformations, provides accurate information about the anatomy and variability of the PNS [1]. Asymmetry of the ethmoidal fovea, olfactory fossa (OF), anatomical changes in the lateral lamella, and the course of the anterior ethmoid artery are all important concerns in FESS since they can lead to iatrogenic injury. As a result, a preoperative computed tomography (CT) scan is required before to FESS[2].

The cribriform plate of ethmoids forms the floor of the OF, which is a depression in the anterior cranial cavity. The anterior cerebral fossa is separated from the nasal cavity by this fragile bony plate. OF is bordered on the outside by the lateral lamella of the cribriform plate and on the inside by the crista galli [3]. The olfactory bulbs and tracts are found here. In the anterior skull base, the lateral lamella is the thinnest bone. In up to 14% of patients, it is dehiscent [4].

Depending on the vertical extent of the lateral lamella, the levels of the ethmoid roof/fovea ethmoidalis and cribriform plate might vary even within the same person. In 1962, Keros

investigated the link between the OF and the ethmoid roof in 450 skulls. For the depth of the OF in respect to the ethmoid roof, he devised a three-category grading system. The vertical height of the lateral lamella of the cribriform plate (LLCP), or the differential between the cribriform plate and the ethmoid roof, is used to determine the depth of OF[5-7]. The depth of Keros type I is 1-3 mm, type II is 4-7 mm and type III is 8-16 mm.
Much research on the ethmoid roof and OF based on Keros classification have been undertaken among many populations after Keros. Varied racial populations have different ethmoid roof configurations. In the Indian setting, there is a scarcity of data on OF analysis. Our goal is to use Keros classification to measure variations in CT depth of OF among the people of India.

Materials and Methods

After receiving approval from the Research and Human Ethical Committee, the study was carried out at our institution. The study looked at patients over the age of 16 who were referred for noncontrast CT of the PNS by various clinical specialties over a period of 1 year (June 2018 to June 2019). Patients having a history of nasal or paranasal injuries, operations, congenital deformities of the face, sinonasal polyposis, malignancies or bone destruction disorders were excluded.
GE Hispeed 16 slice helical tomography machine was used to obtain all CT images. With the patient prone, images were taken perpendicular to the hard palate, from the anterior margin of the frontal sinus to the anterior margin of the clivus. The tomographic images were acquired using the following technical parameters: 120kV tube voltage, 160 effective mAs, 1 s rotation time, 4 mm section thickness, and a field of view of 15 cm.
GE HP workstation 4.7 version was used to analyse the CT images. In this investigation, only coronal slices were used. In the bone window, the photos were examined. The anatomical structures/points listed below were identified and used to determine the depth of the OF: 1. Plate cribriform LLCP 23. The ethmoidal roof point on the medial side (medial end of ethmoid roof articulating with LLCP).
Horizontal lines were drawn along the cribriform plate and at the point where the medial ethmoid roof meets the cribriform plate. Using the distance measuring tool, the vertical height of the lateral lamella was measured between these two horizontal lines. The depth of OF corresponds to the vertical height of the lateral lamella. Both the right and left lateral lamella heights were measured individually. Keros type I was assigned to OF depths of 1-3.9 mm, type II to 4-7.9 mm, and type III to 8 mm (figure 1).

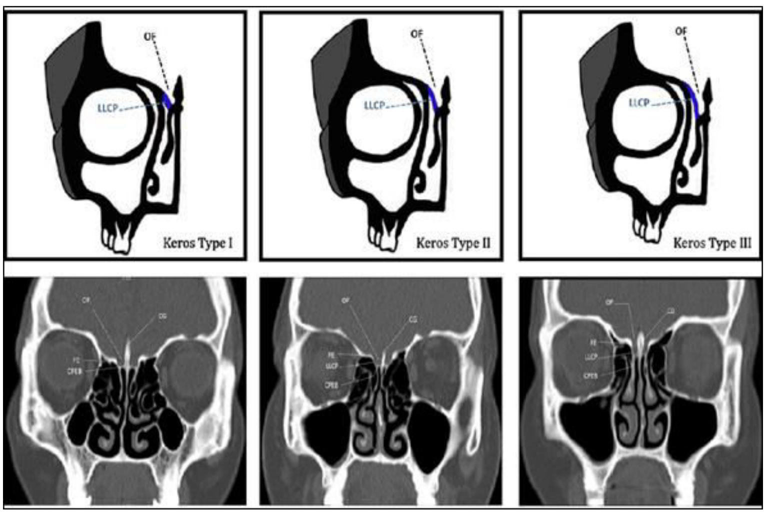

Fig 1: Keros Classification

IBM SPSS Statistics Ver 20.0 was used for statistical analysis [8]. The findings were categorizedusing the Keros categorization system and their distributions were evaluated by gender and laterality. The statistical significance was set to $P < 0.05$.

Results

A total of 600 PNS CT images were used in the investigation. There were 334 males (55.8%) and 266 females among the 600 participants (44.3 percent). The youngest subject was 17 years old, while the oldest was 86. The study group's average age [standard deviation (SD)] was 36.76 (13.82) years.

The depth of OF varied between 1 and 14 mm. The average depth of the 1200 OF examined was 5.16 mm, with a standard deviation of 1.59 mm. On the right side, the mean depth of OF was 5.17 mm with an SD of 1.62, while on the left side, the mean depth was 5.15 mm with an SD of 1.55. The P result for the independent sample t test was 0.479, indicating that there was no significant difference in the mean depth of OF on both sides. Males had a mean OF depth of 5.23 mm with an SD of 1.63, while females had a mean OF depth of 5.07 mm with an SD of 1.52. The P value for the independent sample t test was 0.022. Between boys and girls, there was a statistically significant difference in the mean depth of OF [Table 1].

Keros type I was found on 210 (17.5%) of the total 1200 sides, type II on 895 (74.6%), and type III on 95 sides (7.9 percent). On the right side, 106 (17.7%) OF had Keros type I, 440 (73.3%) had Keros type II, and 54 (9%) had Keros type III. On the left side, 104 (17.3%) OF were Keros type I, 455 (75.8%) were Keros type II, and 41 (6.8%) were Keros type III [Table 2].

Table 1: Distribution of OF depth

	OF depth total	OF depth right	OF depth left	OF depth male	Of depth female
Mean	5.16	5.17	5.15	5.23	5.07
N	1200	1200	600	669	531
SD	1.59	1.62	1.55	1.63	1.52

Table 2: Distribution of OF according to the side and Keros classification

Keros type	Right n(%)	Left	Total
Type I	106(17.7)	104(17.3)	210(17.5)
Type II	440(73.3)	455(75.8)	895(74.6)
Type III	54(9.0)	41(6.8)	95(7.9)
Total	600(100)	600(100)	1200(100)

Discussion

In the Indian context, there are limited in-depth studies on OF analysis, with the exception of a few that are included below. Previously, Salroo*et al.*[9] (200 subjects), Pawar*et al.*[10] (200 subjects), Satish Nair[11] (180 subjects), Ali *et al.*[12] (75 subjects), Gupta *et al.*[13] (100 subjects) and Jacob *et al.*[3] (32 cadaveric skulls) conducted OF analyses in the Indian population from various states, but sample sizes were small and asymmetry analysis Our study is more complete than earlier Indian studies since it focuses on the distribution of Keros kinds and numerous asymmetry factors in detail. In addition, this study is more extensive compared with the previous ones, providing a large data on the Indian population (evaluated 600 subjects; total 1200 OF).

In our investigation, there was a statistically significant link between sex and Keros type, particularly on the right side. However, no statistically significant difference in the distribution of Keros categorization between males and females was found in the study by Salroo*et al.* [9].

In our research, the average depth of OF was 5.26 mm. In the research by Jacob *et al.* and

Salroo*et al.*, the mean depth was 5.08 mm and 4.9 mm, respectively [3,13]. In our study, we found a statistically significant difference in OF depth between males and females, with males having a mean depth of 5.33 mm and females having a mean depth of 5.17 mm, respectively [Table 1]. Salroo*et al.* found a substantial difference in the depth of the OF between males and females [9].

In this investigation, there was no significant variation in the mean depth of OF between the right and left sides. There was no significant variation in OF depth between the sides, according to Jacob *et al.* [3]Salroo*et al.*, on the other hand, found a substantial difference between the two sides in their investigation [9].Pawar*et al.* found a statistically significant difference in OF depth between the right and left sides of the brain, but only in males [10].

Conclusion

The Keros classification helps advise the surgeon during FESS to improve the procedure's safety profile by providing an objective assessment of anterior skull base architecture. It will assist in anticipating potential issues that may arise during surgery. As a result, the surgical approach can be meticulously planned, and potential difficulties can be avoided. Keros type II was the most common form of OF in our study sample. Even though the risky type III OF was uncommon, it was more common in men and on the right side, making them more vulnerable to iatrogenic harm. As a result, a preoperative assessment of OF depth is required to reduce operational complications.

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