ORIGINAL RESEARCH ARTICLE

Anatomical Variations of Olfactory Fossa According to Kero's Classification in Dakshin Karnataka: A Comparison Study with other Races

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A B S T R A C T

Introduction: Sinusitis is one of the commonly diagnosed conditions made in the department of Oto-Rhino-Laryngology. Functional endoscopic Sinus Surgery (FESS) is a minimally invasive technique employed in the treatment of sinusitis. iatrogenic trauma to the skull base particularly the lateral lamella of the cribriform plate is a well know complication which leads to cerebrospinal fluid leakage and anterior ethmoidal artery injury. Hence it is essential for the surgeon to be aware of the variations in the ethmoidal roof and olfactory fossa pre-operatively in order to prevent such complications. In addition to delineating the variations we also compare in our study with different races to find any difference.

Material and methods: The study was conducted on 500 patients from the district of Dakshin Karnataka (South Karnataka who underwent Computed Tomography (CT) of the Paranasal Sinus (PNS) for symptoms of sinusitis. The study was conducted in the department of Radio-Diagnosis of Father Muller Medical College Hospital, Mangalore, Karnataka.

Results: Most common amongst the male population was TYPE I constituting 331 cases (53.3% of type I cases) with left predominance (163 cases) whereas amongst the female population the most common type was that of type II constituting 233 cases (61.6% of type II cases) (Table 2) with right predominance (120 cases). Type III had only 2 cases in our study which was detected in the male population with left side predominance.

Conclusion: In conclusion, our study states that Keros Type 1 olfactory fossa in more common in the sample population in Dakshin Karnataka and the least common in Type III which is in agreement with a similar study performed in South India. Type I is more common Is males and Type II more common in females.

Keywords: Sinusitis, Paranasal Sinuses, Multi Detector Computed Tomography, Race, Anatomic Variants, Functional Endoscopic Sinus Surgery.

INTRODUCTION

Sinusitis is one of the commonly diagnosed conditions made in the department of Oto-Rhino-Laryngology, leading to a large amount of absenteeism and decrease in productivity of quality and quantity of work (1,2). The milder forms are treated medically whereas the recurrent and un-resolving cases are treated surgically (1). Over the years, the surgical management has evolved from open surgical techniques to minimally invasive techniques. Functional endoscopic Sinus Surgery (FESS) is a minimally invasive technique employed in the treatment of sinusitis[1,2]. FESS is known to be an excellent technique with significant reduction in the symptoms and the disease process itself. It has also drastically reduced the rate of complications post-surgery in comparison to other techniques. However, iatrogenic trauma to the skull base particularly the lateral lamella of the cribriform plate is a well know complication which leads to cerebrospinal fluid leakage and anterior ethmoidal artery injury[1,2,3]. Hence it is essential for the surgeon to be aware of the variations in the ethmoidal roof and olfactory fossa pre-operatively in order to prevent such complications[1,2,3]. In addition to delineating the variations we also compare in our study with different races to find any difference. Olfactory depth measurement is calculated and classified according to Kero's Classification. Study aimed to evaluate the variations in ethmoid roof using the KEROS classification in a sample representative of South Indian Population.

MATERIAL AND METHODS

The study was conducted on 500 patients from the district of Dakshin Kannada (South Karnataka who underwent Computed Tomography (CT) of the Paranasal Sinus (PNS) for symptoms of sinusitis. The study was conducted in the department of Radio-Diagnosis of Father Muller Medical College Hospital, Mangalore, Karnataka. The study was done over an approximate period of 2 years from July 2015 to July 2017. Ethical clearance was obtained from the institutional

ethical committee. Informed consent was obtained from all patients participating in the study.

Inclusion criteria

- All patients aged between 18 and 90 years with clinical suspicion of sinusitis

Exclusion criteria

- Patients aged less than 18 years and above 90 years
- Patients with neoplastic lesions of the PNS.
- Patients with fractures/trauma to the PNS.
- Patients unwilling to participate in the study.

CT PROTOCOL: Patient in prone position with 16 slice Helical Multi Detector CT (GE Bright Speed), 1.25 mm thickness, coronal sections in bone window, Kv: 120 and mAs: 100-150.

Olfactory depth measurement was calculated according to the protocol used by Shama and Montaser[3]. The olfactory fossa depth was calculated from the coronal sections at the section of maximum depth by drawing three lines. Line A: Horizontal line connecting the bony boundaries of orbital foramina (inferior). Line B: Vertical line joining the junction of lateral lamella and fovea ethmoidalis with line A. Line C: Vertical line joining lateral bony boundary of cribriform plate to that of Line A.

STATISTICAL ANALYSIS

Data was analysed by descriptive statistics using Statistical Package for Social Sciences (SPSS) 16.0 version. Percentage frequency distribution was also used.

RESULTS

A total of 500 patients participated in the study which included 261 (52.2%) female patients and 239 (47.8%) male patients.

Total number of 1000 olfactory fossae were examined i.e. 500 patients with two olfactory fossa's each.

We divided the patients according to Kero's classification into three groups. TYPE 1: included 620 (62%) olfactory fossae, TYPE II: included 378 (37.8%) and TYPE III: included 2 olfactory fossae (2%) (Table 1).

Most common amongst the male population was TYPE I constituting 331 cases (53.3% of type I cases) (Table 2)

Keros type	Right (n)		Left (n)		Total (n)
	Male	Female	Male	Female	
I	168 (27%)	135 (21.7%)	163 (26.2%)	154 (24.8%)	620 (100%)
II	85 (22.4%)	120 (30.7%)	60 (15.8%)	113 (29.8%)	378 (100%)
III	1 (100%)	0	1 (100%)	0	2 (100%)

Table-1: Frequency distribution of keros classfication into gender wise distribution

Keros type	Symmetery	
	Male (%)	Female (%)
I	68.2	51.7
II	25.1	43.2
III	100	0

Table-2: Symmetry of olfactory fossae

			Keros type		
			I	II	III
Overall	Right	Mean	2.53 +/- 0.71	5.91 +/-1.25	N/A
		Median	2.75	6.3	N/A
		Range	0.40-3.87	4.1-7.8	N/A
	Left	Mean	2.50 +/- 0.65	5.81 +/-1.27	8.4 +/- 0.28
		Median	2.68	5.9	8.4
		Range	0.40-3.57	4.1-7.2	8.2-8.6
Male	Right	Mean	2.52 +/- 0.71	6.2 +/-1.3	8.4 +/- 0.28
		Median	2.73	6.45	8.4
		Range	0.40-3.87	4.5-7.8	8.2-8.6
	Left	Mean	2.49 +/- 0.68	5.45 +/-1.12	8.4 +/- 0.28
		Median	2.67	5.6	8.4
		Range	0.51-3.57	4.1-7.2	8.2-8.6
Female	Right	Mean	2.49 +/- 0.66	6.1 +/-1.22	N/A
		Median	2.68	6.2	N/A
		Range	0.40-3.74	4.1-7.8	N/A
	Left	Mean	2.52 +/- 0.70	6.0 +/-1.3	N/A
		Median	2.7	6.15	N/A
		Range	0.40-3.57	4.5-7.2	N/A

Table-3: Relation between keros type and height in right and Left olfactory fossae.

Figure-1: (a), (b) and (c) show Keros type I, II and III respectively.

with left predominance (163 cases) whereas amongst the female population the most common type was that of type II constituting 233 cases (61.6% of type II cases) (Table 2) with right predominance (120 cases) (Table 2). Type III had only 2 cases in our study which was detected in the male population with left side predominance (Table 2).

Symmetrical/ identical olfactory fossae where detected in Type I in 68.2 % of male patients in comparison the female patients had 51.7% of symmetrical fossae. Whereas, in Type II, 25.1% and 43.2 % of the olfactory fossae showed symmetrical fossae. Type III was detected in one case only which showed symmetry.

The overall mean value of Type I on the right side was 2.53 +/- 0.71 and on the left side 2.50 +/- 0.65, with the female population showing a lower mean value on the right side and a higher value on the left side in comparison with the male populations.

The overall mean value of Type I on the right side was 5.91 +/-1.25 and on the left side 5.81 +/-1.27, with the female population showing a lower mean value on the right side and a higher value on the left side in comparison with the male populations.

DISCUSSION

This study was conducted on 500 patients in the department of Radio-Diagnosis, father Mullers Medical College Hospital, which a female predominant population. We tried to classify the olfactory fossae according to Kero's Classification (Figure-1).

Keros classified the olfactory fossa into three types based on the relation of the ethmoid roof and the cribriform plate and the depth of the olfactory sulcus[4]. A depth of 1-3 mm of the olfactory sulcus was classified as type I, 3-7 mm as type II and >7 mm as type III[4]. He stated that the type III due to the anatomical relations of the lateral lamella forming majority of the olfactory sulcus and in addition to being thin w.r.t, poses a great risk of iatrogenic trauma[4]. Hence, a type III olfactory sulcus must gain the attention of the radiologist and the treating surgeon and care and precautions must be taken to avoid iatrogenic trauma.

In our study only one case of Type III was detected in a male patient where in both olfactory fossae where Type III. Most common was that of Type 1 constituting 331 cases. Type 1 Keros was more common in the male population and Type II in female population.

In comparison to other races and population samples, results are varied. The original study By Keros stated that Type II was more common, this study was based on a population based in Germany[4]. Similar studies agreeing with Keros included, one study on an Egyptian population[3] and three studies on a Turkey population[5-7] and a single study on a Brazilian population[8] wherein Type II Keros was more common. However, few studies including population group based in Egypt[2], USA[9], Philippines[10] and Nepal[11], Keros type I as more common. A similar study performed in South India[12] states Keros type 1 as the most common.

CONCLUSION

In conclusion, our study states that Keros Type 1 olfactory fossa in more common in the sample population in Dakshin Karnataka and the least common in Type III which is in agreement with a similar study performed in South India. Type I is more common Is males and Type II more common in females.

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