The Anatomical Study of Superior and Middle Turbinates from Endoscopic Perspective

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Abstract

Introduction: Endoscopic Sinus Surgery (ESS) is a well-established tool for examining the nasal cavity and in observing the anatomic details. It is also helps in providing the local and medical therapy of infectious diseases of the paranasal sinuses. However, it requires considerable experience and expertise as many normal variations in the middle meatal anatomy have been reported.

Aim: To study the relation between the middle and superior turbinates from the point of view of an endoscopist.

Method: The distances and angles between the limen nasi and the anterior attachments of the middle turbinate and superior turbinate were studied in 100 hemisected adult Indian cadaveric heads.

Results: The mean angles between the limen nasi and the anterior attachments of the middle turbinate and superior turbinate respectively are *a1* is 65.41° and *a2* is 42.48°. The mean distance between the lowermost portion of limen nasi and the anterior attachment of middle turbinate and of superior turbinate are *d1* is 34.79 $\pm$ 3.27 mm and *d2* is 45.47 $\pm$ 4.42 mm.

Key words: Endoscopic, Anatomy, Middle, Superior, Turbinate

Access this article online	
Quick Response Code:	Website: www.innovativepublication.com
	DOI: 10.5958/2394-2126.2016.00045.1

Introduction

Normally the nose is not considered to be a 'vital organ', but indeed it is! To understand its importance all that most people need to experience is a bad cold. And especially in the present scenario with the advanced modalities of treatment, nasal anatomy with respect to nasal conchae has become very significant for the otorhinologists.

Nasal turbinates and the underlying clefts are the characteristics of the lateral wall of nose. It is the middle osteomeatal complex which represents the final common pathway for the drainage and ventilation of the frontal, maxillary and anterior ethmoidal air cells. The obstruction of this region is a key factor in the development of chronic sinusitis[1].

Endoscopy is widely recognized as a safe, convenient, and cost efficient tool for examining the nasal cavity and is very useful in observing the anatomic details of the nasal cavity and sinuses. Endoscopic sinus surgery (ESS) is also of great help in the local and medical therapy of infectious diseases of the paranasal sinuses. Target oriented, focused therapy of the middle meatus practically negates the use of surgical intervention, when in the past fenestration of the inferior meatus would have been almost routine [2].

There have been many reports describing the anatomy of the lateral nasal wall. However, there are few reports describing the middle turbinate which is believed to be very important landmark when performing ESS. So this present study was designed to examine the anatomy of middle turbinate in fully exposed hemisected nasal cavities. The aim was at finding such variations in the anatomy of middle turbinate and its relation of the middle turbinate with the superior turbinate, which may have clinical implications and thus provide guidelines to endoscopic surgeons, especially in Indian populations. Objectives were to study the middle turbinate and superior turbinate in detailed manner:

1. To study the angles between the line passing through the lowermost portion of limen nasi and the anterior attachments of middle turbinate and superior turbinate i.e. *a1* and *a2* respectively.
2. To study the distance between the lowermost portion of limen nasi and the anterior attachments of middle turbinate and superior turbinate i.e. *d1* and *d2* respectively.
3. Comparison between the left and right side readings of the above mentioned parameters.
4. To provide Indian data for above mentioned parameters.
5. To note any variations.

Materials and Method

One Hundred hemisected adult Indian cadaveric heads were used in this study. These were obtained from the cadavers used for gross anatomical dissections by different medical and dental colleges. Due permission was obtained from the concerned authorities of these medical colleges, prior to beginning the study. Consent was not required being a cadaveric study.

Fifty two of these hemisected adult cadaveric heads involved the right side and forty eight involved the left side. Their ages ranged from 25 years to 75 years. Eight six specimens were obtained from male cadavers and fourteen were from females. No specimen showed evidence of prior nasal surgery or gross pathology of their middle turbinates.

Wherever available the 'body cutting machine' was used to obtain the hemisections. At other places, a saw was used for the same. Wherever present the nasal septum was cut with the help of long scissors, scalpel and toothed forceps, so as to view the lateral nasal wall directly. Any secretions, dust etc. was cleared off from the surface and underneath the superior turbinate, middle turbinate and Inferior turbinate. This made the area of study clearly visible. The measurements were taken from the lowermost portion of limen nasi, the anterior most landmark when inserting the endoscope and other surgical instruments. Vernier Caliper and a protractor were used for measurements. The protractor was leveled with the help of 'acrylic cutting machine'.

The middle turbinate and superior turbinate were studied as illustrated in schematic Fig. 1 and 2. The angles and distances were measured from the lowermost portion of the limen nasi. Careful measurements were done and recorded. The measures for each parameter were recorded and their means were statistically analysed.

Results

A) Angles: The mean angles between the line passing through the limen nasi and the anterior attachment of the middle turbinate and the horizontal line containing the lowermost portion of the limen nasi and floor of the nasal cavity i.e. *a1* is 65.41° (range is 54° to 78°).

The mean angle between the line passing through the lowermost portion of the limen nasi and the anterior attachment of the superior turbinate and the horizontal line containing the lowermost portion of the limen nasi and the floor of the nasal cavity i.e. *a2* is 42.48° (range is 30° to 55°).

B) Distances: The mean distance between the lowermost portion of limen nasi and the anterior attachment of middle turbinate i.e. *d1* is 34.79 $\pm$ 3.27 mm.

Similarly the mean distance between the lowermost portion of limen nasi and the anterior attachment of the superior turbinate i.e. *d2* is 45.47 $\pm$ 4.42 mm.

Discussion

Angles:

1. Lee et al. have reported these angles to be 67.9° (range is 51° to 84°) and 45.4° (range is 32° to 56°) respectively for *a1* and *a2*[3]. These readings are almost similar to the present study. (Table 1)
2. Unlu et al. have reported that the angle between the anterior nasal spine and the anterior attachment of the middle turbinate was 56.19° in males and 61.15° in females[4]. (Table 1)
3. This difference may be explained in two ways. First, the limen nasi was used as the standard point in the first two studies instead of either the nasal sill or the anterior nasal spine. Second, ethnic differences may have played a role.
4. The lowermost portion of limen nasi is considered to be the standard point, as it is the anterior most landmark when inserting the endoscope and other surgical instruments in ESS to the target structure.
5. Also, comparison between the left and right side readings were done for these parameters. (Table 2)
6. The mean value of *a1* for left side is 64.19° and for right side is 66.54°.
7. For *a1*, the right side readings are greater than those on the left side and the p value is 0.03 (less than 0.05). So this difference is **statistically significant.**
8. The mean value of *a2* for left side is 42.23° and for right side is 42.71°.
9. The right side readings were found to be greater than the left side. However, these are not statistically significant.
10. The mean, mode and median values for *a1* and *a2* are almost equal indicating that the values are normally distributed. (Table 3)

Distances:

1. Lee et al. reported *d1* to be 37.5 mm (range: 27.8 to 48.9 mm)[3]. This is almost similar to the present study. (Table 4)
2. Turgut et al. reported that the distance between the anterior nasal spine and the anterior attachment of the middle turbinate was 50 mm[5]. (Table 4)
3. Lang reported that the distance between the nasal sill and the lowermost portion of the rim of anterior nares, and the anterior attachment of the middle turbinate was 41.6 mm[20]. (Table 4)

This difference of readings in these studies could be because of two reasons. First, the limen nasi was used as the standard point in the first two studies instead of either the nasal sill or the anterior nasal spine. Second, ethnic differences may have played a role.

4. Lee et al. reported *d2* to be 48.9 mm (range: 34.3 to 60.0 mm). These findings are almost similar[3]. (Table 4)
5. Also, comparison between the left and right side readings were done for these parameters. (Table 5)

The mean value of *d1* for left side is 34.86 mm and for right side is 34.73 mm.

The mean value of *d2* for left side is 45.77 mm and for right side is 45.19 mm. Though the values are greater for left side compared to right side, these are not statistically significant.

6. The mean, mode and median values for *d1* and *d2* are almost equal indicating that the values are normally distributed. (Table 6)
7. **Case: Broad and posteriorly displaced middle turbinate (Fig. 1):** When observed keenly it is noticed that, the distance between anterior attachment of middle turbinate to the anterior border of lateral wall of nose, is more than the distance between anterior attachment of middle turbinate and anterior attachment of superior turbinate as compared to other cases.

This distance would actually determine ***a1*** (The angle between the anterior attachment of the middle turbinate and the horizontal line containing the lowermost portion of the limen nasi and floor of the nasal cavity) and ***a2*** (The angle between the anterior attachment of the superior turbinate and the horizontal line containing the lowermost portion of the limen nasi and the floor of the nasal cavity) **angles** i.e. if this distance is more (middle turbinate is posteriorly displaced), then *a1* and *a2* are smaller and vice versa.

This distance will be found to be different depending upon different regions and different races i.e. because of ethnic variations.

Table 1: Comparison between the *a1* and *a2* in the studies

	Angles (in degree)		
	Present study	**Lee et al. study**	**Unlu et al. study**
a1	65.41°	67.9°	56.19°(♂),61.15°(♀)
a2.	42.48°	45.4°	

a1 = Angle between lower most portion of limen nasi and anterior attachment of middle turbinate.
a2 = Angle between lowermost portion of limen nasi and anterior attachment of superior turbinate.

Table 2: Comparison between left and right sides for *a1and a2*

	Angle *a1* (in degree)		**Angle *a2* (in degree)**	
	Left	**Right**	**Left**	**Right**
Mean	64.19	66.54	42.23	42.71
Variance	30.28	28.84	29.24	29.27
Observations	48	52	48	52
Df	98		98	
t Stat	-2.16		-0.45	
P value	0.03		0.66	

df = Degree of freedom

It is observed from the table above that the overall mean readings for *a1* on the right side are higher as compared to left side, which are **statistically significant** (as the P value is less than 0.05).

It is similarly observed from the table above that the overall mean readings for *a2* on the right side are higher as compared to left side. They are statistically not significant.

Table 3: Mean, mode, median etc. values for *a1, a2*

Angles	***a1* (in degree)**	***a2* (in degree)**
Mean	65.41	42.48
Standard Error	0.55	0.54
Median	65	42.5
Mode	65	40
Standard Deviation	5.53	5.39
Minimum	54	30
Maximum	78	55
Count	100	100

Table 4: Comparison between the *d1* and *d2* in the studies

	Distances in mm			
	Present study	**Lee et al. study**	**Turgut et al. study**	**Lang's study**
d1	34.79 ± 3.27	37.5	50	41.6
d2	45.47 ± 4.42	48.9	-	-

d1 = Distance between lower most portion of limen nasi & anterior attachment of middle turbinate.
d2 = Distance between lowermost portion of limen nasi & anterior attachment of superior turbinate.

Table 5: Comparison between left and right sides for *d1* and *d2*

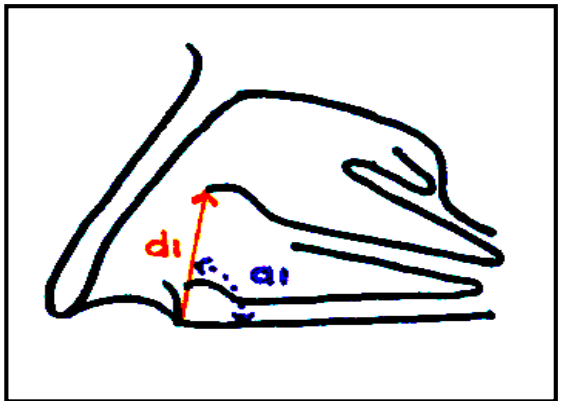
	Distance *d1* (mm)		Distance *d2* (mm)	
	Left	**Right**	**Left**	**Right**
Mean	34.86	34.73	45.77	45.19
Variance	11.73	9.99	20.36	18.99
Observations	48	52	48	52
Df	98		98	
t Stat	0.20		0.65	
P value	0.85		0.52	

df = Degree of freedom

It is observed from the table above that the overall mean readings on the left side are higher as compared to right side. They are statistically not significant.

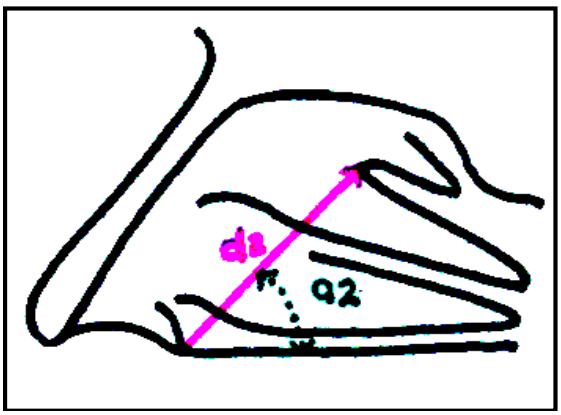
Table 6: Mean, mode, median etc. values for *d1, d2*

Distances	*d1* (mm)	*d2* (mm)
Mean	34.79	45.47
Standard Error	0.33	0.44
Median	34.78	44.92
Mode	32.64	40.06
Standard Deviation	3.27	4.42
Minimum	28.18	36.22
Maximum	45.12	56.2
Count	100	100



Schematic Fig. 1: Measurement of *a1, d1*

a1 = Angle between lower most portion of limen nasi and anterior attachment of middle turbinate.
d1 = Distance between lower most portion of limen nasi and anterior attachment of middle turbinate.



Schematic Fig. 2: Measurement of *a2, d2*

a2 = Angle between lowermost portion of limen nasi and anterior attachment of superior turbinate.
d2 = Distance between lowermost portion of limen nasi and anterior attachment of superior turbinate.

Fig. 1: Broad and posteriorly displaced middle turbinate and obliquely grooved inferior turbinate

Conclusion

For *a1*, the right side readings are greater than those on the left side and the p value is 0.03 (less than 0.05). So this difference is **statistically significant.**

The angles and distance between the lowermost portion of limen nasi and the anterior attachments of middle turbinate and superior turbinate and the variations in these parameters would set guidelines for endoscopic surgeons.

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