

# Paradoxical Curvature of Middle Turbinate: A Computed Tomographic Study

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## ABSTRACT

**Introduction:** The superior, middle and inferior conchae (turbinate) are present in the lateral wall of nasal cavity. Conchae normally bend medially toward the nasal septum. If they bend in the reverse direction, this is called 'paradoxical curvature'. Paradoxical curvature of the middle concha (turbinate) may lead to impingement of the middle meatus and thus to sinusitis. The purpose of our study was to analyze the prevalence of paradoxical curvature of middle turbinate and its relationship with age and sex.

**Material and methods:** Sinonasal computed tomographic images of 100 subjects obtained from the Department of Radiodiagnosis, King George's medical University, Lucknow in the period Aug 2013 to July 2014 were analyzed to determine the prevalence of paradoxical curvature of middle turbinate and its relationship with age and sex.

**Results:** Out of total 100 subjects studied, paradoxical curvature of middle turbinate was seen in 12 subjects out of which 7 were males and 5 females. It was found in higher proportion in females (13.16%) as compared to males (11.29%) but this difference was not found to be statistically significant ( $p=0.780$ ). The prevalence of unilateral Paradoxical middle turbinate was more frequent as compared to bilateral (4%) but the difference was statistically insignificant ( $p=0.679$ ).

**Conclusion:** No correlation between age intervals and prevalence of paradoxical curvature of middle turbinate was found.

**Keywords:** Paradoxical Curvature, Middle Turbinate, Computed Tomographic Images, Conchae

## INTRODUCTION

The middle turbinate is an important landmark which forms the medial wall of the ethmoid sinus. It is associated with many functions of the nasal cavity including humidification, lubrication of the upper airways, regulation of airflow and temperature, olfaction and filtration.<sup>1</sup> The middle turbinate configuration is usually the same as that of inferior turbinate (i.e. convex medially). This is considered to be normal curvature of middle turbinate. As an anatomic variant, when the convexity is reversed and faces laterally it is called Paradoxical middle turbinate.<sup>2,3</sup>

The aim of the present study was to determine the overall prevalence of paradoxical curvature of middle turbinate using coronal and axial CT. We also compared the prevalence of paradoxical middle turbinate age wise and gender wise.

## MATERIAL AND METHODS

Sinonasal computed tomographic images of 100 subjects (62 males and 38 females) were collected from the Department

of Radiodiagnosis, King George's Medical University, Lucknow, in between Aug 2013 to July 2014 and were analyzed for the presence of normal and paradoxical curvature of middle turbinate. The variations that were found were identified and noted.

## Inclusion criteria

All patients male or female, 15 to 60 years of age, undergoing computed tomography of sinonasal region, in the Department of Radiodiagnosis, King George's Medical University were included in our study.

## Exclusion criteria

Any person with obscured or altered sinonasal anatomy due to inflammatory disease, previous surgery, facial trauma and paranasal sinus neoplasms.

## Method

Coronal sections were performed with the patients in prone position with neck extended and the plane perpendicular to axial plane. Axial sections were performed with the patient in supine position and the plane of data acquisition parallel to hard palate. The sections were taken with slice thickness of 5 mm.

In our study we considered normal curvature of middle turbinate when its convexity faces medially and when its convexity faces laterally we called it Paradoxical middle turbinate (Earwaker, 1993).<sup>3</sup>

## RESULTS

Normal curvature of middle turbinate i.e. convexity facing medially (Fig.3) was present in higher proportion in males (88.71%) as compared to females (86.84%). The middle turbinate was paradoxically curved in 12 subjects (12%) out of which 7 were males and 5 females. It was found in higher proportion in females (13.16%) as compared to males (11.29%) but this difference was not found to be statistically significant ( $p=0.780$ ). The prevalence of unilateral Paradoxical middle turbinate was more frequent as compared to bilateral (4%) but the difference was

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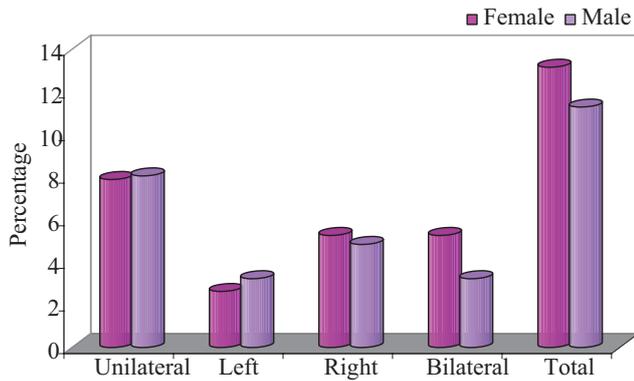


Figure-1: Bar diagram showing Genderwise comparison of prevalence of Paradoxical Middle turbinate.

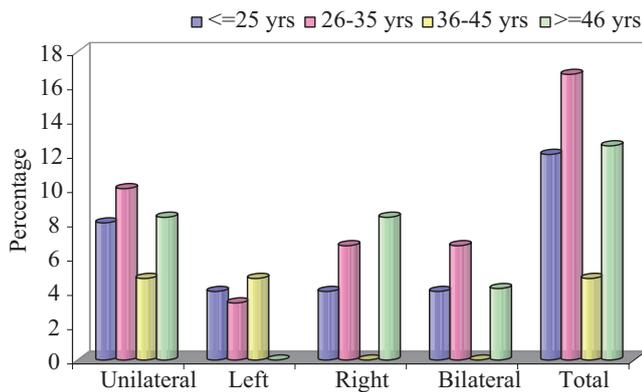


Figure-2: Bar diagram showing Agewise comparison of prevalence of Paradoxical curvature Middle turbinate.

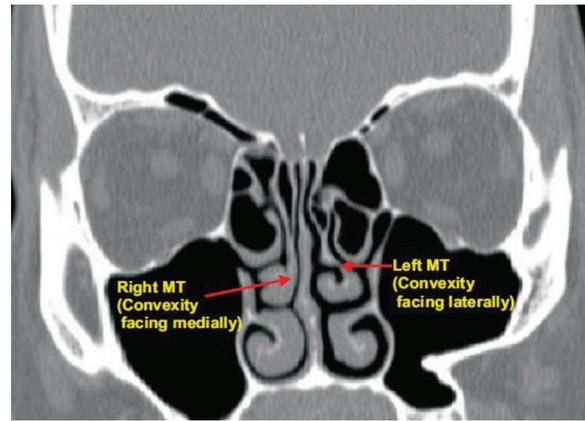


Figure-3(a): Coronal CT image showing paradoxical middle turbinate (MT) in left side

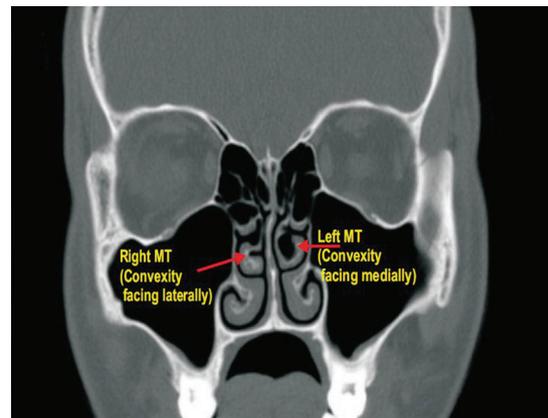


Figure-3(b): Coronal CT image showing paradoxical middle turbinate (MT) in right side

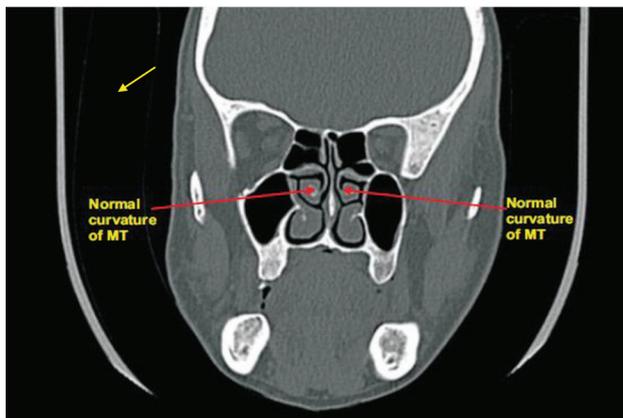


Figure-3: Coronal CT image showing normal curvature of middle turbinate (MT)

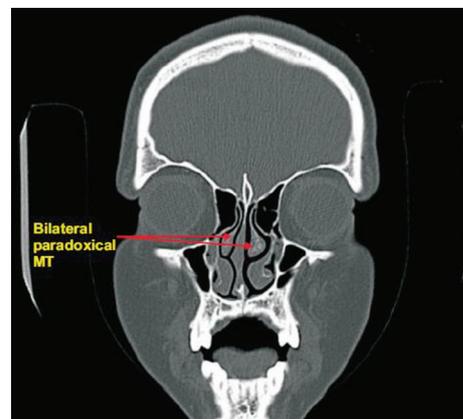


Figure-3(c): Coronal CT image showing bilaterally paradoxical middle turbinate (MT)

Middle Turbinate	Females (n=38)		Males (n=62)		Statistical Significance	
	No.	%	No.	%	$\chi^2$	'p'
Normal	33	86.84	55	88.71		
Paradoxical middle Turbinate						
Unilateral	3	7.89	5	8.06	0.001	0.976
Left	1	2.63	2	3.23	0.029	0.866
Right	2	5.26	3	4.84	0.009	0.925
Bilateral	2	5.26	2	3.23	0.255	0.614
Total	5	13.16	7	11.29	0.078	0.780

Table-1: Genderwise comparison of Presence of Normal curvature of middle Turbinate and Paradoxical curvature of Middle Turbinate

Middle Turbinate	<25 yrs (n=25)		26-35 yrs (n=30)		36-45 yrs (n=21)		>46 yrs (n=24)		Statistical Significance	
	No.	%	No.	%	No.	%	No.	%	$\chi^2$	'p'
Normal	22	88	25	83.33	20	95.24	21	87.5		
Paradoxical middle Turbinate										
Unilateral	2	8.00	3	10.00	1	4.76	2	8.33	0.466	0.926
Left	1	4.00	1	3.33	1	4.76	0	0.00	1.064	0.786
Right	1	4.00	2	6.67	0	0.00	2	8.33	1.895	0.595
Bilateral	1	4.00	2	6.67	0	0.00	1	4.17	1.432	0.698
Total	3	12.00	5	16.67	1	4.76	3	12.50	1.666	0.644

**Table-2:** Agewise comparison of Presence of Normal and Paradoxical Middle Turbinate

Author(year)	Population	N	Type of study	Paradoxical MT %
Bolger et al <sup>7</sup> (1991)	Caucasian	202	CT	26.1
Lloyd et al <sup>9</sup> (1991)	British Population	100	CT	15
Tonai et al <sup>8</sup> (1996)	Japanese	75	CT	25.3
Perez et al <sup>6</sup> (2000)	Spanish	110	CT	10
Badia et al <sup>10</sup> (2005)	UK Population	100	CT	20
Lerdlum et al <sup>11</sup> (2005)	Thai	133	CT	5.3
Mazza D et al <sup>5</sup> (2007)	Italian	100	CT	11
Present Study (2014)	Indian	100	CT	12

**Table-3:** Prevalence of Paradoxical Middle Turbinate (MT) in different population. N: Number of Subjects.

statistically insignificant ( $p=0.679$ ). Unilateral Paradoxical curvature was found in higher proportion in males (8.06%) as compared to females (7.89%) but this difference was not found to be statistically significant ( $p=0.976$ ). Left sided (Fig.3a) Paradoxical turbinate was found higher in males (3.23%) as compared to females (2.63%) whereas right sided (Fig.3b) paradoxical turbinate was found higher in females (5.26%) as compared to males (4.84%). The gender wise difference in prevalence of unilateral paradoxical turbinate was neither significant on left side ( $p=0.866$ ) nor on the right side ( $p=0.925$ ). Bilateral Paradoxical middle turbinate (Fig.3c) was found in higher proportion of females (5.26%) as compared to males (3.23%) but this difference was not found to be statistically significant ( $p=0.614$ ) (Table.1, Fig.1).

The prevalence of normal curvature of middle turbinate was found to be higher in subjects aged 36-45 years (95.24%) followed by subjects aged <25 years (88.00%), >46 years (87.5%) and subjects aged 26-35 years (83.33%). Paradoxical middle turbinate was found in higher proportion in subjects aged 26-35 years (16.67%) as compared to >46 years (12.50%), <25 years (12.00%) and 36-45 years (4.76%) but this difference was not found to be statistically significant ( $p=0.644$ ). Paradoxical middle turbinate on any one side (Left or right) was found in only 8 subjects. Though it was found in slightly higher proportion in subjects aged 26-35 years (10.00%) as compared to aged >46 (8.33%), aged <25 years (8.00%) and 36-45 years (4.76%) but this difference was not found to be statistically significant ( $p=0.926$ ). Left sided paradoxical middle turbinate was found in higher proportion of subjects aged 36-45 years (4.76%) as compared to subjects <25 years (4.00%) and 26-35 years (3.33%) but this difference was statistically insignificant ( $p=0.786$ ). Right sided paradoxical middle turbinate was found in

higher proportion of subjects aged >46 years (8.33%) as compared to 26-35 years (6.67%) and <25 years (4.00%) but the difference was non significant ( $p=0.595$ ).

Bilateral paradoxical middle turbinate was found in higher proportion in subjects aged 26-35 years (6.67%) as compared to >46 years (4.17%) and <25 years (4.00%) but this difference was not found to be statistically significant ( $p=0.698$ ) (Table.2, Fig.2).

## DISCUSSION

Paradoxical middle turbinate occurs if the convexity of the middle turbinate is directed towards the medial wall of the maxillary sinus. Stammberger and Wolf (1988)<sup>4</sup> accepted paradoxical curvature of the middle concha as an etiologic factor for sinusitis because it may lead to impingement of the middle meatus causing obliteration or alteration in nasal air flow dynamics.

The reported prevalence of paradoxical middle turbinate in the literature ranges from 5.3% to 26.1%. In our study, paradoxical middle turbinate was observed in 12 patients (12%). Almost similar prevalence was observed in Italian (11%)<sup>5</sup> and Spanish population (10%).<sup>6</sup> Higher prevalence was reported in Caucasian<sup>7</sup>, Japanese,<sup>8</sup> British population<sup>9</sup> whereas in Thai population prevalence was low (5.3%)<sup>11</sup> (Table 3).

### CT: Computed Tomography

Possible reason for this discrepancy could be the ethnic differences of the populations studied or selection of study group, as some studies were performed on patients with sinus pathology whereas some studies included asymptomatic, non pathological subjects.

In the present study we found higher prevalence of unilateral (8%) paradoxical middle turbinate as compared to bilateral (4%) insignificantly which akin with the findings of Dutra et

al, (2002)<sup>12</sup> who studied 71 Brazilian subjects and reported a higher prevalence of unilateral paradoxical middle turbinate curvature (20%) as compared to bilateral (14%).

In the present study paradoxical turbinate was found in 12 (12.0%) subjects. Though it was found in higher proportion in females (13.16%) as compared to males (11.29%) but this difference was not found to be statistically significant ( $p=0.780$ ) similar to the observations by Kayalioglu et al, (1999).<sup>13</sup>

We found a higher prevalence of paradoxical middle turbinate in subjects aged 26-35 years (16.67%) as compared to others [ $>46$  years (12.50%),  $<25$  years (12.00%) and 36-45 years (4.76%)] but this difference was not found to be statistically significant ( $p=0.644$ ) as was also reported in previous literature (Kayalioglu et al, 1999; H.Mamatha et al, 2010).<sup>13,14</sup>

## CONCLUSION

In this study Paradoxical middle turbinate was found in 12% subjects with higher proportion in females (13.16%) as compared to males (11.29%) but statistically insignificant. Unilateral Paradoxical curvature was more common in males (8.06%) as compared to females (7.89%) whereas bilateral Paradoxical middle turbinate was more common in females (5.26%) as compared to males (3.23%).

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