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## Research Article

### ANATOMICAL VARIATIONS IN THE MIDDLE TURBINATE IN PATIENTS WITH CHRONIC RHINOSINUSITIS: A RADIOLOGICAL STUDY

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#### ABSTRACT

Anatomical variations in ostiomeatal complex have been implicated in causation of chronic sinusitis. We have attempted to study the occurrence of anatomical variations of the middle turbinate and their causal relationship with occurrence of chronic rhinosinusitis. In our study CT coronal sections of ostiomeatal complex of 50 adult patients, diagnosed to have chronic rhinosinusitis were analysed for anatomical variations. Data was analysed by frequency, percentage and by Chi Square test. Excel software was used to analyze the statistical data. Concha bullosa was seen in 32% of the patients, paradoxical bent middle turbinate in 10%, Combination of paradoxical bent and concha bullosa was seen in 1 case. Anatomical variation in middle turbinates were seen in 14 (28%) out of 44 patients with PNS mucosal abnormalities and 6 (12%) out of 6 patients without PNS mucosal abnormalities. Results show that presence of anatomical variants in middle turbinate alone does not mean a predisposition to sinus pathology.

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## INTRODUCTION

Some of the suggested causes for chronic rhinosinusitis are the anatomical variations seen in ostiomeatal complex which may lead to obstruction of the natural ostium of sinuses. Understanding of these variations is important in evaluation of a patient with chronic rhinosinusitis, as this can assist in effective management as well as prevent potential complications of current endoscopic sinus surgery. The investigative modalities presently available for the clinician are many, such as X ray, CT scan, DNE etc.

With the advent of functional endoscopic sinus surgery (FESS) and coronal computed tomography (CT) imaging of paranasal sinuses, considerable attention has been directed toward paranasal region anatomy. Conventional radiograph does not provide a detailed study of paranasal sinuses and has been largely replaced by computerised tomographic (CT) imaging. CT scanning is standard imaging in evaluation of paranasal sinuses as it gives the detailed study of anatomical views, and anatomical variations that are often seen in a patient with chronic rhinosinusitis.

Computerized Tomography (CT) provides essential preoperative information for the assessment of patients undergoing functional endoscopic sinus surgery (FESS). It

delineates the extent of the disease, defines any anatomical variants and relationship of the sinuses with the surrounding important structures. As a rule, surgeons individualize their surgical approach according to the extent and location of disease they see on CT scan.

In our study, the anatomical variations of middle turbinate has been evaluated.

#### Variations of middle turbinate

##### Concha Bullosa

A concha bullosa is an aerated turbinate, most often the middle turbinate, less commonly, of the inferior and superior turbinate. Concha bullosa is a normal variant and is one of the most common variations of sinonasal anatomy, often bilateral and is identified in ~35% (range 14-53%) of patients.<sup>1</sup> Although middle turbinate pneumatization has been suspected as a potential cause of middle meatal obstruction and resultant sinusitis, the definitive relationship between concha bullosa and sinusitis is debatable. A concha bullosa involving the middle turbinate may enlarge the turbinate, so that it obstructs the middle meatus or the infundibulum. Concha bullosa cells can experience the same inflammatory disorders that affect the paranasal sinuses, and obstruction of the drainage of a concha may lead to mucocele formation.<sup>2</sup>

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Concha bullosa of the middle turbinate can be divided into one of three types:

- lamellar : pneumatisation of the vertical lamella of the <sup>2</sup>
- bulbous : pneumatisation of the bulbous segment
- extensive (total) : pneumatisation of both lamellar and bulbous parts.<sup>3</sup>

They are associated with deviation of the nasal septum away from the concha bullosa, with preserved surrounding air spaces (suggesting developmental asymmetry rather than mass effect).<sup>4</sup>

#### **Paradoxical bent**

Normally, the convexity of the middle turbinate bone is directed medially, toward the nasal septum. As with the concha bullosa, the most significant paradoxical turbinates involve the middle turbinate. In 26% of patients, the convexity is directed laterally towards the lateral nasal wall.<sup>5</sup> The inferior edge of the middle turbinate may assume various shapes with excessive curvature, which in turn may narrow and / or obstruct the nasal cavity, infundibulum and middle meatus. Because of this potential narrowing or obstruction, paradoxical middle turbinates can be a contributing factor to sinusitis. Occasionally, the mucosa around the concha may be deformed where the mucosa starts to fold inward and resembles a boxing glove with the knuckle portion directed toward the floor of the nasal cavity.

#### **Secondary Middle Turbinate**

Secondary middle turbinate (SMT), a rare variation of the nasal cavity, is a bony projection covered by soft tissue that arises from the lateral nasal wall. The medially bent and anteriorly folded uncinate process, the so-called “accessory middle turbinate”, can resemble a SMT, however, its location is helpful in the differentiation.<sup>6</sup> Coronal CT scan makes it easy to detect. The recognition of this variation is important since it may predispose to inflammatory sinus disease, by narrowing the ostiomeatal complex.

#### **Duplicate Turbinates**

Another rare anomaly is a duplicate turbinate, in which two of the same turbinate occupy the same region. The vertical and concha portions are exact copies of the original turbinate. When this occurs in the region of the middle turbinate, the presence of the additional turbinate can narrow and compromise the ethmoidal infundibulum.

#### **Turbinate to Turbinate Attachment**

Attachment of one turbinate to another turbinate, and not the lateral wall of the nasal cavity, is a very rare anomaly. Spur can arise from the turbinate and may interfere with the airflow, depending on its location.

#### **Other Variations**

Additional variations of the middle turbinate can occur, including medial displacement, lateral displacement, lateral bending, L-shape and sagittal transverse clefts. Medial displacement of the middle turbinate is the result of the other meatal structures encroaching upon the middle turbinate. Lateral displacement of the middle turbinate is usually due to

the compression of the turbinate toward the lateral nasal wall by a septal spur or septal deviation. Either or these two variations may predispose to sinus disease. A bifid inferior turbinate is an extremely rare anatomical variation and only few cases have been reported to date.<sup>7</sup>

#### **Aims and objectives**

To study the occurrence of anatomical variations of the middle turbinate in study population.

To assess causal relationship of anatomical variations of middle turbinate with occurrence of chronic rhinosinusitis.

## **MATERIALS AND METHODS**

All adult patients of greater than 20 years of age, attending the ENT Outpatient department at Father Muller Medical College from March 2015 to March 2016, diagnosed to have chronic rhinosinusitis and willing to undergo Computed Tomographic evaluation were included in this study.

Patients aged <20 years, those with previous alteration of the paranasal sinus anatomy due to facial trauma, etc., patients with tumours of the sinonasal mucosa and those who underwent previous sinus surgery were not included in the study.

Sample of 50 were selected using purposive sampling technique. Computed tomography (plain study) images with Coronal sections of ostiomeatal complex were collected. After preliminary lateral topogram of the skull, scanning defined the region from root of frontal sinus upto the hard palate. All CT scans were obtained with GE Brightspeed scanner (16 slice MDCT scanner). Coronal sections were performed with the patients in prone position, with extended neck and the plane perpendicular to the infraorbitomeatal line. The sections were taken with slice thickness of 2.5mm. The scans thus generated were photographed at appropriate window widths and window level. They were analysed for anatomical variations using a soft parts window and a bone density window.

## **RESULTS**

Collected data was analysed by frequency, percentage and by Chi Square test. Excel software was used to analyze the statistical data.

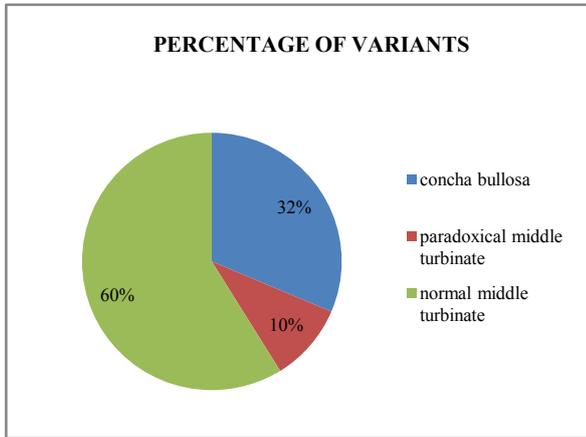
During the period of 12 months of the study 50 patients who fulfilled inclusion criteria were studied, out of which 23 were female and 27 were male. Of the 50 cases studied, allergic symptoms were present in 7 patients, and polypoidal changes were seen in 6 patients. Mucosal abnormalities of sinuses were noted in 44 (88%) patients overall, maxillary sinus was involved in 32 (64%), ethmoidal sinus was involved in 22 (44%), frontal sinus was involved in 17 (34%). 45 (90%) patients presented some anatomical variant and, in many, more than one variant was present in the same subject.

Concha bullosa was seen in 32% of the patients, paradoxical bent middle turbinate in 10%, Combination of paradoxical bent and concha bullosa was seen in 1 case.

In our study 44 (88%) patients had PNS mucosal abnormalities and 6 (12%) patients had no mucosal abnormalities.

Anatomical variation in middle turbinates were seen in 14 (28%) out of 44 patients with PNS mucosal abnormalities and 6 (12%) out of 6 patients without PNS mucosal abnormalities. From this observation our study also reveals that the presence of anatomical variants in middle turbinate alone does not mean a predisposition to sinus pathology.

#### Anatomical Variants of Middle Turbinate



Graph 1

#### DISCUSSION

The term ostiomeatal unit, was originally coined by Naumann, to identify its importance in pathogenesis of sinusitis.<sup>8</sup> The ostiomeatal unit is subject to a large variety of anatomical variations in this region and are important as they may have pathological consequence or may be the source of difficulty/ complication during surgery. Stammberger *et al* proposed that stenosis of the ostiomeatal complex, from either the anatomical configuration or hypertrophied mucosa, can cause obstruction and stagnation of secretions that may become infected or perpetuate infection.<sup>9</sup>

Concha bullosa (pneumatized middle turbinate) has been implicated as a possible aetiological factor in the causation of recurrent chronic sinusitis. It is due to its negative influence on PNS ventilation and mucociliary clearance in the middle meatus region. The presence of a concha bullosa has ranged between 4% and 80% in different studies; our data gave 32% which is less compared to 53.6% observed by Bolger and Zinreich S *et al* (36%),<sup>10</sup> and more compared to incidence reported by Dua K (16%) and Peres *et al* (24.5%). Such a wide range of incidence is due to the criteria of pneumatization adopted.<sup>11,12,13</sup> The middle turbinate may be paradoxically curved i.e. bent in the reverse direction. This may lead to impingement of the middle meatus and thus to sinusitis. In our study it was found in 11 patients (11%) - 8 unilateral, 3 bilateral. The incidence of 11% in our study is close to the 10% incidence described by Peres *et al*.<sup>11</sup> Bolger *et al*. and Stammberger & Wolf detected the presence of anatomical variants both in patients studied for sinus problems and in those studied for other reasons.<sup>14, 15</sup>

They concluded that the simple presence of variants does not mean a predisposition to sinus pathology, except when other associated factors are present. This opinion is not shared by Yousem, who claimed that the anatomical variants may be predisposing factors, depending on their size.<sup>16</sup> In our study 44 (88%) patients had PNS mucosal abnormalities and 6 (12%) patients had no mucosal abnormalities. Anatomical variation were seen in 40 (28%) out of 44 patients with PNS mucosal abnormalities and 6 (12%) out of 6 patients without PNS mucosal abnormalities.

From this observation our study also reveals that the presence of anatomical variants does not mean a predisposition to sinus pathology. However, it is important for surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications. The radiologist must pay close attention to anatomical variants in the preoperative evaluation and help avoid possible complications and improve success of management strategies.

#### CONCLUSION

Presence of anatomical variants in middle turbinate alone does not mean a predisposition to sinus pathology.

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