Anatomical Variations of Uncinate Process Observed in Chronic Sinusitis

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Abstract Chronic Sinusitis, an extremely persistent illness, is surgically best treated by Functional Endoscopic Sinus Surgery. The ostiomeatal complex is the main area targeted and within it uncinat process is the first anatomical structure encountered. The significance of anatomical variations concerning age and sex of uncinat process in chronic sinusitis were evaluated. A prospective study on 50 patients of chronic sinusitis (100 uncinat processes) was done. The results were tabulated and analyzed using Statistical Package for Social Science (SPSS) 16.0. Type I superior attachment of uncinat process (67 %) was the most common variety in all ages and both sexes and a statistically significant relationship between Type I superior attachment of uncinat process and sex was found ($p < 0.05$). The typical uncinat process was most common (70 %) followed by medial deviation of the uncinat (24 %). This difference in occurrence was significant with respect to both age and sex ($p < 0.05$). Anatomical variations of uncinat process are not

responsible for causing chronic sinusitis. Mere presence of these variations of uncinat is not an indication for FESS.

Keywords Chronic sinusitis · Middle meatus ·
Uncinat process

Introduction

Chronic sinusitis is a sinus infection that has persisted for longer than 3 months with symptoms usually being nasal obstruction, facial fullness and nasal discharge. Medical management of chronic sinusitis must be supplemented surgically with removal of diseased mucosa obstructing the sinus ostia, allowing improved sinus ventilation and drainage [1].

All cases of chronic sinusitis are associated with anatomical variations and/or pathological abnormalities of ‘the ostiomeatal area’. Due attention, during the diagnosis and treatment of chronic sinusitis, should be given to this region for any anatomical variations and/or pathological abnormalities in order to avoid recurrence [2].

Uncinat process is a key landmark principal to Functional Endoscopic Sinus Surgery and is the first structure removed. Its anomalies are reportedly the most common anomaly encountered in the nasal cavity in individuals with chronic sinusitis [3]. Preoperative detection of anatomic variations of the uncinat helps avoid intra-operative damage to the nasolacrimal duct, medial orbital wall, sphenopalatine artery etc. and therefore is important surgically [4, 5].

Numerous studies describing anatomical and pathological variations of the ostiomeatal complex after analyses of computed tomography sections of patients with chronic sinusitis are found in the literature [6–11], but there are very few nasal endoscopic studies [12, 13].

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The present study was undertaken to assess the significance of anatomical variations of the uncinate process of patients with chronic sinusitis. The objectives were to study the anatomical variations of the uncinate, using diagnostic nasal endoscopy and computed tomographic scan, to see their rate of occurrence and main associations among them and rate of occurrence concerning gender and age of patients.

Materials and Methods

A prospective study was carried out in our ENT Department from 2007 to 2010 on 50 patients with the clinical diagnosis of chronic sinusitis not responding to 2 weeks of medical treatment and willing to undergo endoscopic sinus surgery and computerized tomographic (CT) scanning of paranasal sinuses were included in the study. Patients with a history of previous endoscopic sinus surgery, with chronic sinusitis responding to medical management and those not consenting to participating in the study were excluded.

Examination and Technique

A detailed history and a thorough clinical examination were done. Diagnostic nasal endoscopy and CT scanning of paranasal sinuses (coronal and axial section) were done to assess the anatomy and variations of the uncinate process.

Assessment of Anatomical Variations

The morphological definitions for different anatomical variations, identified endoscopically and correlating with radiological findings, were defined beforehand as per anatomic terminology group [14, 15].

The typical uncinate process has been described as a thin, bony hook like leaflet with an almost sagittal orientation, running from anterosuperior to posteroinferior. Its concave posterosuperior free margin is parallel to the anterior surface of the ethmoid bulla. The uncinate process attaches to the perpendicular process of the palatine bone and the ethmoid process of the inferior turbinate with bony spicules. The convex anterior margin is in contact with the bony lateral nasal wall and may extend up to the lacrimal bone. The uppermost segment of the uncinate process is not visible behind the insertion of the middle turbinate endoscopically [14, 15].

The anatomic variations of uncinate process were defined as [14, 15]:

1. Superior attachment of uncinate could be to
 - a. Type I—the uncinate process bends laterally in its upper most portion to be inserted into the lamina papyracea,

- b. Type II—the uncinate process extends superiorly to the roof of the ethmoid, that is the skull base,
- c. Type III—the superior end of the uncinate process turns medially and is attached to the middle turbinate

2. Medially bent uncinate process
3. Laterally bent uncinate process
4. Pneumatized uncinate process or uncinate bulla.

Statistical Analysis

The comparison of different anatomical variations of uncinate, variations in superior attachment of uncinate and their main associations concerning the gender and different age groups was conducted using the Chi square statistical test with Statistical Program for Social Science (SPSS) version 16.0. A p -value < 0.05 was considered statistically significant.

Results

The patients presenting to us with chronic sinusitis were in the range of 9–60 years. The age group of 21–35 (30 %) was the most affected. Males outnumbered the females in ratio of 2:1.

In our study, the typical uncinate was seen in 70 % cases, variations were present in only 30 % cases. We found incidence of medially deviated uncinate process to be 24 % ($n = 24$), lateral deviation of uncinate process in 2 % ($n = 2$) and pneumatized uncinate process or uncinate bulla in 4 % ($n = 4$) (Table 1).

The typical uncinate was the most frequent type of uncinate process in all the age groups. Medial deviation was the most frequent variation of uncinate process observed in all the age groups and was significant on Chi square test (Fig. 1).

In both the sex groups typical uncinate was the most frequent: males 60.6 % ($n = 40$), females 88.2 % ($n = 30$) and the most frequent variation was medial deviation observed in: males 30.3 % ($n = 20$), females 11.7 % ($n = 4$), the difference in frequency of these variations with respect to sex being significant (Table 2).

Out of the possible 100 sides superior attachment of uncinate process could be identified definitely for 84 sides. Type I uncinate process was seen in 67 (79.8 %) of 84 sides. Type II uncinate process was the second most common seen in 14 (16.67 %) of 84 sides and Type III was seen in 3 (3.57 %) of 84 sides.

We observed that the superior attachment of the identifiable uncinate ($n = 84$) was most frequently to lamina papyracea (Type I) in all the age groups and both sexes (Fig. 2; Table 3). While the frequency of Type I superior attachment of uncinate was not significant with respect to

Table 1 Baseline characteristics of the population studied

Variables	Number of cases (100)
Gender	
Male	66
Female	34
Age group (years)	
5–20	24
21–35	38
36–50	26
51 and above	12
Superior attachment of uncinate process	
Non	16
Type I	67
Type II	14
Type III	3
Other anatomical variation of uncinate process	
Typical	70
Medial deviation	24
Lateral deviation	2
Pneumatized	4

Fig. 1 Observed anatomical variation of uncinate process in relation to age of the patient ($\chi^2 = 18.10$, $df = 9$, $p = 0.034^*$)**Table 2** Observed anatomical variation of uncinate process in relation to sex of the patient

Variables	Male	Female	χ^2 , df , p
Observed anatomical variation of uncinate process			
Typical	40.00	30.00	$\chi^2 = 8.75$, $df = 3$, $p = 0.033^*$
Medial deviation	20.00	04.00	
Lateral deviation	02.00	00.00	
Pneumatized	04.00	00.00	

* $p < 0.005$

age, the frequency with relation to sex in cases of chronic sinusitis was significant.

Discussion

Sinusitis is a very common health care challenge in the developed and developing world. The obstruction of the

Fig. 2 Superior attachment of uncinate process in relation to age of the patient ($\chi^2 = 11.36$, $df = 9$, $p = 0.252$)**Table 3** Superior attachment of uncinate process in relation to sex of the patient

Variables	Male	Female	χ^2 , df , p
Superior attachment of uncinate process			
Non	16	00	$\chi^2 = 12.379$, $df = 3$, $p = 0.006^*$
Type I	38	29	
Type II	09	05	
Type III	03	00	

* $p < 0.005$

ostioameatal complex, is regarded the most important in the pathophysiology of rhinosinusitis [13]. The uncinate process, being one of the first structures encountered intra-operatively, is now given immense surgical importance [3–5]. Zinreich et al. [16] first observed that the uncinate process may be curved or bent, impairing sinus ventilation especially in the anterior ethmoid, frontal recess and infundibulum. Variations of uncinate process in our series were found in only 30 % cases. This was similar to that of 30 % reported by Aiyer et al. [13] but higher than that of 2.5 % reported by Bolger et al. [7] and 2 % by Asruddin et al. [17] and lower than that of 45 % reported by Wanamaker [18] and 65 % reported by Mamatha et al. [19].

Our series found the prevalence of medially deviated uncinate process to be 24 % and lateral deviation of uncinate process in 2 % in contrast to Krzeski et al. [6] who found medial deviation of uncinate in 8.6 % cases and lateral deviation in 9.55 % and Cagici et al. [20] who reported a medial deviation of uncinate process in 12 % and lateral deviation in 4 % patients. Medial deviation was the most frequent variation of uncinate process observed in all the age groups and both sexes and the association were significant on Chi square test. This variation of medial deviation has been implicated in narrowing of the infundibulum producing impaired sinus ventilation by Nayak et al. [21].

Pneumatized uncinate process or the uncinate bulla was found in 4 % cases in our study exclusively in males. This was comparable to the incidence of uncinate bulla found by Bolger et al. [7] of 2.5 % and by Arslan et al. [22] of 2 %

but higher than 0.96 % found by Krzeski et al. [6] in their study of CT scan (PNS) of 157 patients.

However, the most common type of Uncinate Process observed in chronic sinusitis was the typical variant ($n = 70$). This occurrence was significant in both sexes and all ages, challenging the belief that narrowing due to variation of uncinate is responsible for development of sinusitis.

Out of the possible 100 sides superior attachment of uncinate process superior attachment of uncinate process could not be identified definitely for 16 (16 %) sides which was lower than that of 34.71 % reported by Krzeski et al. [6] and 40 % reported by Landsberg and Friedman [9] but similar to 26 % reported by Turgut et al. [10].

The most commonly seen superior attachment in our series was Type I uncinate process in 79.8 % cases. This was higher than that reported by Krzeski et al. [6] (17.83 %), Min et al. [8] (54 %) and Landsberg and Friedman [9] (52 %). Type II uncinate process was the second most common seen in 16.67 % sides and Type III uncinate process was seen in 3.57 %. These were lower than that reported by Krzeski et al. [6] of Type II being 33.12 % and Type III 14.33 % and Min et al. [8] who found that the superior attachment of the uncinate was to skull base in 24.5 % sides (Type II) and to middle turbinate in 21.5 % (Type III). However, in all these studies the most common type of attachment was to lamina papyracea and least common to skull base, a trend reflected in our study.

We found the occurrence of typical uncinate and its variants differs significantly in patients with chronic sinusitis with regards to age and sex, the exception being occurrence of superior attachment of uncinate and age. However, no significant correlation among the prevalence of the anatomical variations of uncinate process has been reported by Santos Jr. et al. [12], neither isolated nor associated, related to sex.

A detailed analysis of coronal plane CT scans of the paranasal sinuses by Bolger et al. [7] was done to study anatomic variations of the sinuses which included a pneumatized uncinate process. They found that the bony anatomic variations were detected in 131 (64.9 %) of 202 patients. However, these were found with a similar frequency in patients scanned for sinus complaints and in those scanned for non-sinus reasons.

Tonai and Baba [23] analyzed tomographic studies of PNS of 75 adult patients and noted the incidence of anatomical variations of the lateral nasal wall in patients with sinus complaints and with those without it. Comparison of anatomical variants incidence in the symptomatic and asymptomatic groups showed no significant difference. He further found that incidence of mucosal abnormalities in the anterior ethmoid was more common in patients with chronic sinusitis.

Similarly we found that majority of the patients with chronic sinusitis had no variation of the uncinate process (70 %) and this difference was significant. Further, the most common superior attachment of the uncinate was to the lamina papyracea (Type I), a variant not narrowing the infundibulum.

The effect of uncinectomy without sinusotomy and natural ostial dilatation on maxillary sinus ventilation in chronic rhinosinusitis was studied by Kutluhan et al. [24] and they found that the mean maxillary sinus pressure during inspiration was significantly decreased to a negative value after uncinectomy. Presence of anatomical variations of the uncinate process alone in patients of chronic sinusitis cannot be justified as an indication for uncinectomy. Injudicious removal of the uncinate process especially in cases with allergic rhinosinusitis can expose the sinus mucosa to contaminated air causing persistent or even worsening of the mucosal disease in the ethmoid cavity and its dependent major sinuses [21].

Conclusions

In conclusion, bony anatomical variations of the uncinate do not appear to influence the occurrence of rhinosinusitis and thus indiscriminate uncinectomy is to be condemned. Intrinsic mucosal disease is probably of much more importance than the bony anatomy. There are still many lacunae in our knowledge. Influencing factor of the superior attachment of the uncinate process in development of chronic rhinosinusitis needs further exploration. Those who lack a good grasp of anatomy are prone to commit serious and sometimes even fatal mistakes. Despite knowing the various anatomical and pathological variations of uncinate process, we are yet to fully identify how it varies the course of chronic sinusitis.

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Conflict of Interest None.

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