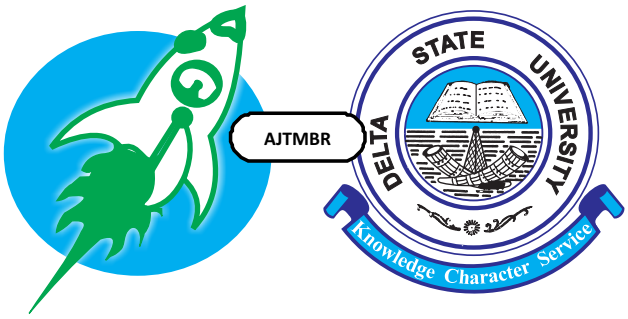
African Journal of Tropical Medicine and Biomedical Research (AJTMBR)



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Focus and Scope

The African Journal of Tropical Medicine and Biomedical Research is a multidisciplinary and international journal published by the College of Health Sciences, Delta State University of Abraka, Nigeria. It provides a forum for Authors working in Africa to share their research findings on all aspects of Tropical Medicine and Biomedical Sciences and to disseminate innovative, relevant and useful information on tropical medicine and biomedical sciences throughout the continent. The journal will publish original research articles, reviews, editorials, commentaries, short reports, case reports and letters to the editor. Articles are welcome in all branches of medicine and dentistry including basic sciences (Anatomy, Biochemistry, Physiology, Pharmacology, Psychology, Nursing etc) and clinical sciences (Internal Medicine, Surgery, Obstetrics and Gynaecology, Dental surgery, Child Health, Laboratory Sciences, Radiology, Community Medicine, etc). Articles are also welcome from social science researchers that document the intermediating and background social factors influencing health in countries of Africa. Priority will be given to publication of articles that describe the application of the principles of primary health care in the prevention and treatment of diseases.

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Table of Contents

A Computed Tomographic Study on The Morphological Variants of The Uncinate Process in A Selected Nigerian Population

Ominde BS[1], Ikubor J[2], Enaohwo MT[1], Iju WJ [1], Igbigbi PS[1]

Abstract

Introduction: The variants of the uncinate process (UP) influence the patency of the osteomeatal complex. They impair the paranasal sinus drainage hence, predispose to chronic rhinosinusitis. They also make endoscopic sinus surgery challenging and increase the risk of iatrogenic complications. This study investigated the different anatomical forms of the UP using computed tomography.

Materials and Methods: Non-contrast cranial Computed Tomographic images of adult patients were obtained from digital archives of a Teaching Hospital (Radiology department) in Nigeria (Delta State) after ethical clearance. The site of superior attachment, orientation, deviation, atelectasis and aeration of the UP were evaluated. The data were reported in frequencies and further compared using the Chi-square test. A p-value of <0.05 implied statistical significance.

Results: The UP commonly inserted superiorly onto the lamina papyraecea (208,61.9%) followed by the middle turbinate (81,24.1%) and the skull base (47,14%). Horizontally oriented UP was more common (197,58.6%) compared to vertical UP (139,41.4%). The prevalence of the uncinate tip deviation was 38.7% (130) medially and 10.7% (36) laterally, with significant sex differences ($p<0.05$). The uncinate bulla was present in 9.5% (32).

Conclusion: This study enlightens on the existing forms of the UP among patients evaluated, thus the need for their identification prior to functional endoscopic sinus surgery to minimize iatrogenic complications.

Keywords: uncinate process, ethmoid, pneumatization, attachment, deviation, orientation

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INTRODUCTION

The uncinate process (UP) is a crescent-shaped projection from the ethmoid bone situated along the lateral border of the nasal cavity.[1] It is bordered by the inferior nasal concha and lacrimal bone inferiorly and anteriorly respectively.[2-4] Posteriorly, the UP possesses a free margin. The osteomeatal complex (OMC), a pathway that drains the antrum of Highmore, anterior ethmoidal plus frontal sinuses, is delineated by the middle concha, ethmoidal infundibulum, ethmoid bulla, uncinate process, hiatus semilunaris, maxillary sinus ostium and the frontonasal recess. [3,4] The UP forms the inferior boundary of the semilunar hiatus and the medial limit of the ethmoid infundibulum.[2-4]

The superior attachment of UP (SAUP) is variable influencing the channel for draining the frontal sinus and affecting the size of its ostium and beak.[1,2] The UP is bound to the lamina papyracea on the medial orbital wall. Subsequently, the frontal sinus drains medial to the UP and directly via the middle nasal meatus.[2]

An enlarged Agger Nasi cell can potentially displace the UP medially causing it to attach onto the middle concha/ turbinate. In this scenario, frontal sinus secretions are directed on the lateral side of the UP via the ethmoidal infundibulum into the middle meatus.[2,3] This drainage conduit is also observed in rare instances where the UP superiorly attaches on to the roof of ethmoid at the cranial base. [2,4] Infundibular disease is more commonly seen when the SAUP allows the frontal sinus air cell recess to open through the infundibulum than straight into the middle nasal meatus.[4]

The UP could be oriented either horizontally or vertically. [4] A vertically oriented UP has the capacity for expansion or deformation while a horizontally oriented one may coexist with a great ethmoid bulla or contralaterally deviated nasal septum. [3,4] The uncinate's upper end could deviate relative to the position of middle nasal meatus, resembling a second middle turbinate. [5] The lateral divergence of the tip constricts the semilunar hiatus and the infundibulum, reducing the gap amid the UP and the orbital papyraceous lamina. Consequently, caution should be exercised during uncinectomy to prevent orbital injury. [4] A medially deviated uncinate tip has been significantly linked to anterior ethmoidal sinusitis resulting from middle meatus obstruction.[5]

The ethmoidal process may be aerated forming an uncinate bulla. [6-8] This variation can impact the extent of OMC patency potentially leading to pansinusitis.[7,6] An atelectatic UP is adherent to the medial orbital wall inferiorly, and is typically associated with a hypoplastic antrum of Highmore or hypoplastic ethmoidal bulla. [7] Identifying this variant preoperatively is essential to prevent accidental injury to orbital contents like the optic nerve during uncinectomy in the course of functional endoscopic sinus surgery (FESS). [7,9]

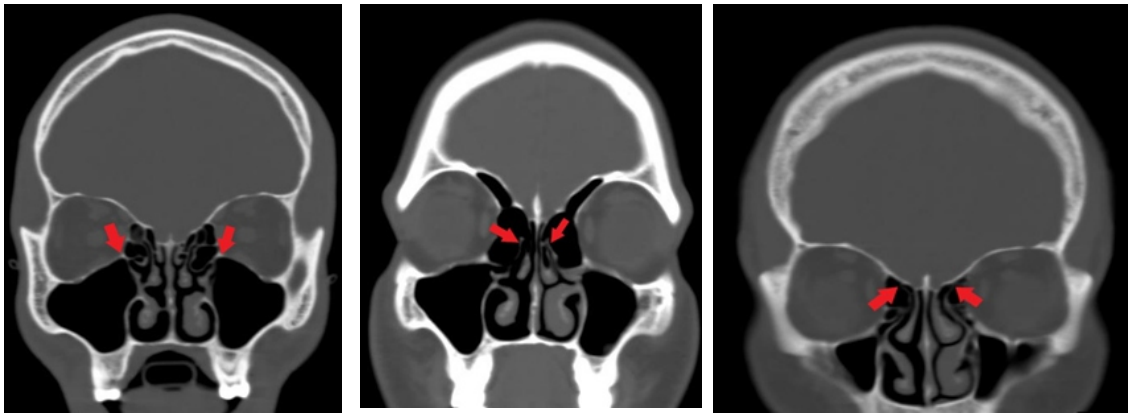
The uncinate's diverse morphological forms can potentially cause OMC obstruction and impede sinus drainage, predisposing to chronic rhinosinusitis which often necessitates FESS.[6] In the literature, structural modifications of the UP exhibit variations among different population groups. [2,5-7] These discrepancies are largely influenced by genetics, racial, locational and ecological factors.[5,7] Recognizing these variants is crucial for achieving better surgical approach to the sinus outflow and minimizing intraoperative complications. [1, 6-9] Consequently, this study focused on utilizing computed tomographic (CT) images to ascertain the distribution of the structural variants of the UP within the adult population in Nigeria.

MATERIALS AND METHODS

This was an observational cross-sectional analysis of retrospective nature, which was undertaken within the Radiology Section of Delta State University Teaching Hospital (DELSUTH) located in Oghara, Nigeria. After reviewing the study's protocol, the hospital's ethical committee granted approval before commencement of this investigation (EREC/PAN/2020/030/0371). Non-contrast brain CT scans captured in a time-frame of 5 years (June 1, 2015 to July 1, 2020) and stored in digital radiological databank were used. These scans were acquired to investigate suspicious diverse pathologies including space occupying lesions, chronic headache, stroke and emboli. Scans of 336 subjects; 137 females and 199 males, aged 20 years and beyond were selected. Patients below this age were not considered due to immaturity of the sinuses which typically reach their adult size by 20 years. [10,11] Poor quality scans with visible artifacts, inadequate exposure, and obscured field of view were also not included. Additionally, images displaying apparent pathological abnormalities,

congenital anomalies or proof of earlier surgery were omitted.

Identification of the UP was conducted on coronal slices. The superior attachment of the UP (SAUP) either on ethmoid lamella (lamina papyracea), middle turbinate, or cranial base was assessed (Figure 1). The uncinate's orientation or alignment either vertically or horizontally besides the deviation of its tip either medially or laterally were evaluated. The uncinate bulla was defined by any extent of pneumatization (Figure 2). Furthermore, any UP adhering onto the inferomedial orbital wall and associated with either a hypoplastic ethmoidal bulla or maxillary sinus was considered as an atelectatic UP. [7,9]



A B C

Figure 1. (Original) Reformatted Coronal CT images of the skull (bone window) depicting the superior attachment of the uncinate process A. On lamina papyraecea B. On middle turbinate C. On skull base

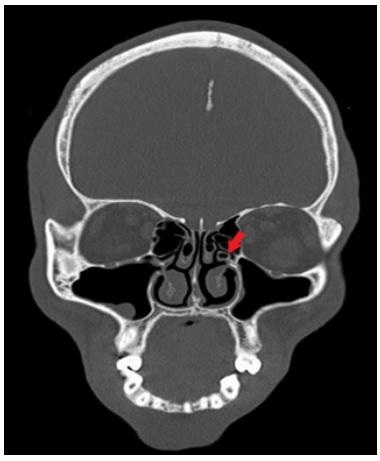


Figure 2 (Original) Reformatted Coronal CT images of the skull (bone window) showing pneumatization of the left uncinate process

The IBM Corporation's Statistical Package for Social Sciences (SPSS) version 23, located in Armonk, New York, USA was employed in the analysis of data. Data were organized by gender and the distribution of the variants represented as percentages. To assess disparities in the frequencies based on side and gender, the Pearson's Chi-square test was applied. A P-value less than 0.05 was regarded as statistically significant.

RESULTS

The prevalent placement of the SAUP was typically on ethmoid lamella, observed bilaterally in 208 (61.9%) (Figure 1A). Subsequently, the SAUP was found on the middle concha/turbinate bilaterally (81, 24.1%) and lastly on the skull base (47, 14%) (Figures 1B and 1C). No significant differences based on gender were observed among these three types of SAUP (P>0.05) (Table 1). Conversely, all the three insertions demonstrated statistically significant dissimilarities between sides (P=0.001 each). Table 2 presents the occurrence of the variant SAUP in different studies.

Table 1. Gender differences in the superior attachment of the UP

Attachment Site	Average (%)	Males (%)	Females (%)	P value
Lamina papyraecea	208 (61.9)	117 (58.8)	91 (66.4)	0.032
Middle turbinate	81 (24.1)	54 (27.1)	27 (19.7)	0.216
Skull base	47 (14)	28 (14.1)	19 (13.9)	0.856

Table 2. The prevalence of variant superior attachment of the UP in different studies (Original)

Author	Country	Lamina papyraecea	Skull base (%)	Middle Turbinate
Arun et al. [1]	India	67.5	18.5	9.5
Oghenero et al. [2]	Nigeria	83	2.2	14
Tuli et al. [8]	India	79.8	16.7	3.6
Kansu, et al. [12]	Turkey	19.8	12	9
Current study	*Nigeria*	*61.9*	*14*	*24.1*

The UP demonstrated equal prevalence in bilateral orientation occurring either vertically or horizontally. Prevailing presence of the horizontally oriented UP (197, 58.6%) followed by vertical orientation (41.4% ,139) were noted. Both indicated noteworthy variations between sides (P=0.001 each) but lacked association with gender (*P*=0.286, 0.230) (Table 3). The uncinate's tip was medially deviated and laterally deviated bilaterally in 130 (38.7%) and 36 (10.7%) patients respectively. These deviations were significantly associated with gender (*P*=0.005, 0.003) and side (*P*=0.001) (Table 3).

Table 3. Orientation of the UP and deviation of the UP tip (Original)

Variant		**Frequencies**			
		N	%	N	%
Orientation of UP		***Vertical***		**Horizontal**	
	Male	77	38.7	122	61.3
	Female	62	45.3	75	54.7
	Total	139	41.4	*197*	58.6
	p value	***0.286***		***0.230***	
Deviation of UP		***Lateral***		**Medial**	
	Male	*13*	*6.5*	*96*	48.2
	Female	*23*	*16.8*	34	24.8
	Total	*36*	*10.7*	130	38.7
	p value	***0.003***		***0.005***	

The frequency of the pneumatized uncinate was 9.5% (32), occurring unilaterally in all the cases. Besides, it did not exhibit any notable differences between sides (p=0.363) or in either gender (*P*=0.413 and 0.473) (Table 4 and Figure 2). Its occurrence differs across various populations as indicated in Table 5. There were no instances of atelectatic UP observed in any of the examined images.

Table 4. Prevalence of uncinate bulla (Original)

Variant		Right		Left		Total	
		N	*%*	*N*	*%*	*N*	*%*
UP Bulla	Male	9	4.5	7	3.5	16	8
	Female	9	6.6	7	5.1	16	11.7
	Total	18	5.4	14	4.2	32	9.5
	p value	*0.413*		*0.473*			

Table 5. Prevalence of the pneumatized UP in different studies (Original)

Author	Country	Pneumatized UP (%)
Fadda et al. [5]	Italy	2.8
Sheikh et al. [6]	India	15.5
Dasar and Gokce, [7]	Turkey	13.8
Gungor and Okur [9]	Turkey	11.6
Tuli et al. [8]	India	4
Kaya et al. [14]	Turkey	4.1
Shpilberg et al. [16]	America	13.5
Abesi et al. [18]	Iran	7.5
Current study	*Nigeria*	*9.5*

DISCUSSION

The superior insertion of the uncinate was on the lamina papyraecea (61.9%), middle turbinate (24.1%) and cranial base (14%) in that descending order of frequencies. These varied from reports by a previous Nigerian study by Oghenero et al. [2] who evaluated CT scans of adults in Osun State. Furthermore, our findings were different from those documented in Turkey and India (Table 2).[1,8,12] Contradicting the accounts provided by Tuli et al., [8] our study found no association between SAUP and gender. However, all the three superior insertions exhibited notable differences between sides which were significant. It is therefore important to recognize the site of uncinate insertion on each side to avoid

aggressive traction and torque which may inadvertently damage the ethmoid roof. [1,12] The SAUP was identical on either sides in all (100%) images assessed, contrary to the observations presented by Kansu [12] who found identical insertion in 46.3%.

We highlight a prevailing occurrence of the horizontally oriented UP bilaterally (58.6%) within our studied demographic. This slightly exceeded the figure earlier reported by Lingaiah et al. [4] in India. Due to its frequent association with great ethmoid bulla or contralaterally deviated nasal septum, a horizontal uncinate should raise the suspicion of the simultaneous presence of the additional two variants which should be identified. [3,13] The prevalence of vertically oriented UP (41.4%) was marginally less than the frequency documented in India. [4] Its recognition is crucial because it is more susceptible to deformation. [2,4]

The UP tip exhibited bilateral medial deviation in 38.7% surpassing the documented figures of 22.8% in Italy and 8.4% in Turkey. [5,14] Alternatively, Mahajan et al. [15] reported a greater prevalence of 52% primarily with bilateral occurrence (58%) among Indians. The bilateral ethmoid processes were deviated laterally in 10.7% exceeding the documented figure of 5.7% in Turkey. [14]In contrast, our prevalence was lesser than the earlier reported rates. [5,15] These differences may stem from variations in race and dissimilarities in the methodologies adopted; either endoscopic or radiological [15] Understanding the uncinate's deviation is essential, as it may be linked to compromised sinus ventilation and present challenges during FESS [4,5,15]

The existence of the uncinate bulla in (9.5%) surpassed the rates in Italy (2.8%) [5]. Our frequency was within the documented ranges in the Indian (4%-15.5%) and Turkish (4.1%-13.8%) populations. [6-8,14] Higher frequencies have been noted in the Americans (13.5%) and Arabs (7.5%) as indicated in Table 5. [16,18] The discrepancies may stem from differing definitions employed in the various studies. We considered any extent of pneumatization or aeration of the UP. However, Bolger et al. [17] reported some pneumatization in 4% and defined an uncinate bulla to be that which is extensively pneumatized. Bolger et al. [17] recognized the occurrence of pneumatized uncinate unilaterally (2%) and bilaterally (0.5%). In Iran, Abesi et al. [18] noted a 29.82% bilateral occurrence while unilateral existence was higher on the left (67.5%) in comparison to the right (32.5%). Counter to these findings, all pneumatized UP herein occurred unilaterally (9.5%) with no preference for either side (P=0.363). These disparities could be linked to race, regional location, and population size. An atelectatic UP was absent and this is aligns with earlier studies that recorded it to be rare, with low frequencies of 0.5-2.5% in Turkey and India. [7,9] Its presence predisposes to the unintentional injury to orbital structures during uncinectomy in FESS. [9]

The population disparities in UP variants might be caused by regional, genetic, environmental and racial factors on the UP morphology. The observed association between UP deviation and gender aligns with the observations by Tuli et al. [8] hence, implying that sex genes and hormones play a significant role in these variants. The significant variations between sides in the morphological UP variants may be linked to the separate intrauterine development of bilaterally existing structures. [3,19]

CONCLUSION

The present study sheds light on the occurrence of the variant structural forms of the UP in adult residents of Delta State, Nigeria. This highlights the importance of preoperative identification to mitigate surgical complications.

Strengths of study

Computed tomographic scans used were suitable since this modality precisely illustrates the skull bones and the intricate organization of the sinonasal region.

Limitation of study

The study omitted CT images featuring sinonasal pathology, preventing a determination of these variants' contribution to chronic rhinosinusitis. The relatively restricted sample size resulted from the retrospective design of this study and the use of CT images from a single center.

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Conflict of Interest: None

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