

Radiological Evaluation of Uncinate Process Variations using Multidetector Computed Tomography

Khadka R¹, Pathak MR¹, Khanal B², Shah RK³

¹Assistant Professor, Department of Radiology, ²Lecturer, Department of Radiology, Birat Medical College and Teaching Hospital, Tankisinwari, Biratnagar, ³Assistant Professor, Department of ENT, Birat Medical College and Teaching Hospital, Tankisinwari, Biratnagar, Nepal.

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ABSTRACT

Introduction: Functional endoscopic sinus surgery has emerged as a superior technique in sinus surgery with a lower incidence of associated complications as compared to traditional surgeries; however, it still carries risks of possible complications, some of which could be attributable to the variations that exist in the nose and paranasal sinus anatomy. Variations in the uncinata process, one of the important structural landmarks in functional endoscopic sinus surgery can have implications during sinus surgery. Therefore, identifying the variations in the uncinata process becomes a very important consideration. The objective of this study was to identify the variations of the uncinata process on Multidetector Computed Tomography of paranasal sinuses

Methods: This cross-sectional study was conducted in the Department of Radiodiagnosis, Birat Medical College and Teaching from December 2021 to June 2022 after obtaining ethical clearance from IRC. A total of 240 participants referred to the Department of Radiodiagnosis for CT of paranasal sinuses were included in the study.

Results: The most frequent superior attachment of uncinata was found to be Type I and the least common was Type IV. The least frequent variation was UP pneumatisation. Most of the cases showed typical angulation followed by medial orientation and lateral orientation.

Conclusion: Variations in the uncinata process exist and Multidetector CT is a commendable tool for identifying these variations.

Keywords: *Computed Tomography; Endoscopy, Paranasal Sinuses*

Correspondence to:

Dr Roshana Khadka

Department of Radiology

Birat Medical College, Tankisinwari, Biratnagar.

Email: roshanakhadka09@gmail.com



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INTRODUCTION

The uncinat e process (UP), is a thin crescent-shaped bony projection arising from the inferior turbinate ethmoidal process, extending anterosuperior to the frontal recess, and is considered one of the lateral nasal cavity's most important landmarks. [1,2] The UP medially borders the ethmoidal infundibulum and has several attachments to the lateral wall of the nasal cavity with the potential for compromising the drainage of the anterior group of the sinuses.[3] UP is a crucial landmark during Functional endoscopic sinus surgery (FESS) and is first removed in endoscopic sinus surgery to allow visualization of the opening of the maxillary sinus and a blind spot during endoscopy is the upper end of UP.[4]

Some variations of UP need to be identified before contemplating FESS surgery. The common variations of the uncinat e process that exist could be in the form of angulation (medialization, lateralization), pneumatization and superior insertion.[5]

Landsberg and Friedman classified the superior attachment of the uncinat e process into six types [6]

- Type I: Insertion to the lamina papyracea
- Type II: insertion to the posteromedial wall of the agger nasi cell
- Type III: insertion to both the lamina papyracea and the junction of the middle turbinate with the cribriform plate
- Type IV: insertion to the junction of the middle turbinate with the cribriform plate
- Type V: insertion to the skull base
- Type VI: insertion to the middle turbinate

CT is the modality of choice, thus playing an important role in directing surgical and medical treatment. To avoid injury to the skull base, lamina papyracea and middle meatus during uncinectomy, preoperative knowledge of anatomy and anatomical variations of the important structures of this region is of utmost importance. The aim of this study, therefore, was to identify the variations in the uncinat e process using CT PNS.

METHODS

An analytical cross-sectional study was performed from December 2021 to June 2022, in the Department of Radio Diagnosis, Birat Medical College and Teaching Hospital on patients attending for CT of paranasal sinuses. Consecutive sampling was done to enrol the patients. The estimated sample size was 240, by applying the formula= $4pq/l^2$, with $p=30$, $q=70$ and $l=6$ (margin of error 20%), the sample size is 233, rounding off to 240. Ethical clearance was taken from the Institutional Board Committee of Birat medical college and Teaching Hospital. Informed consent was taken from the study participants. Patients with previous nasal or sinus surgery, a history of facial trauma, and congenital maxillofacial anomalies were excluded from the study.

All the images were acquired on Siemens 64 multislice scanner with 2 mm slice thickness, and optimal exposure settings of 160 kVp, 120 mA, without injecting IV contrast. The images were reconstructed in the coronal and sagittal planes and the uncinat e process was analyzed in the coronal reconstructed images on the Dicom Viewer operating system using a bone window setting to optimally visualize the anatomy. Superior attachment of UP was traced and classified based on Landsberg and Friedman's classification. [6]

Depending on the degree of angulation in the sagittal plane, the UP were classified into normal angulation: between 100-300; medialization: angulation >300 and lateralization: angulation <100. The results were tabulated accordingly. Data were entered in MS Excel and analyzed by IBM SPSS Statistics 20.

RESULTS

A total of 240 coronal CT mages (480 sides) of the paranasal sinuses were viewed. Among the study groups, 132 were males, 108 were females (Table 1) and the age range was between 12-58 years, with a mean age of 35 years. Out of a total of 480 sides, on 32 sides (6.7%) the superior attachment could not be

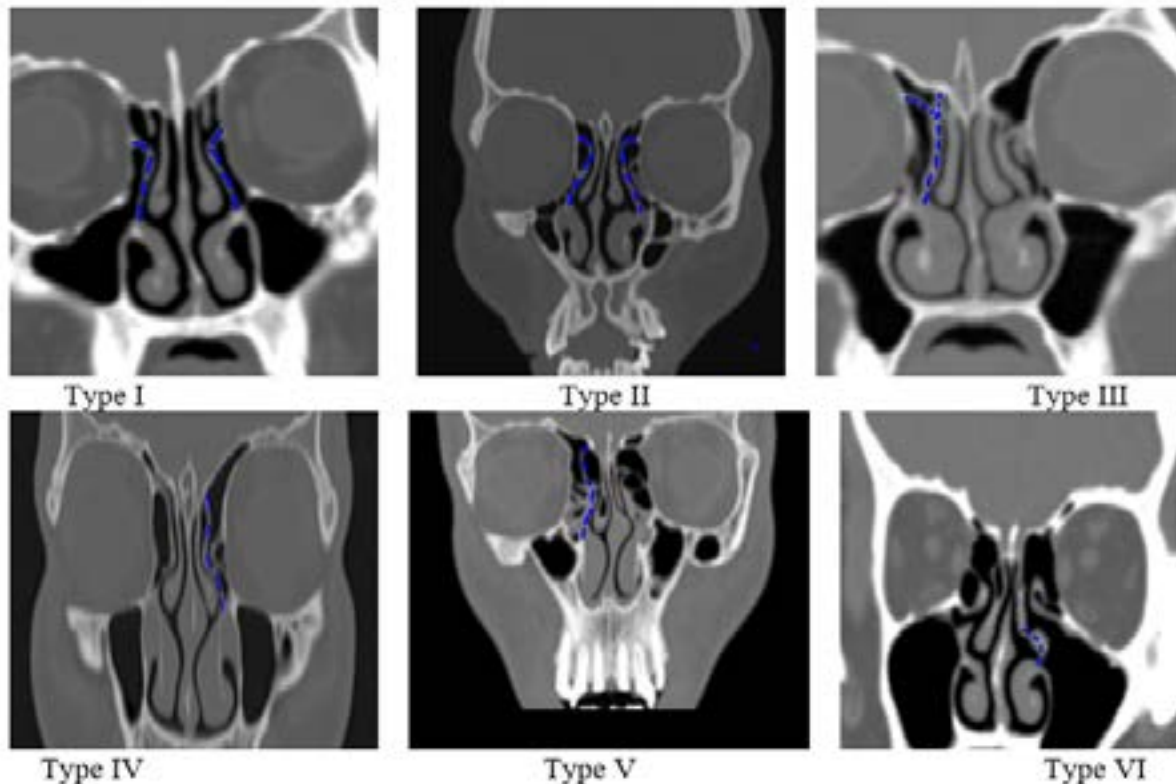


Figure 1: Variations in the superior attachment of uncinate process

assessed. Our study, therefore, showed that for superior attachment of uncinate process in the remaining 448 sides the most frequent and least common variations were Type I and Type IV seen in 131(37.64%) and 19 (5.46%) respectively (Figure 1 and 2). Variation in angulation of UP was seen in 120 (25%) sides, the most common being medial angulation 96 (20%) followed by lateral angulation 19(3.96%) and pneumatized UP 5(1.04%) (Figure 2)

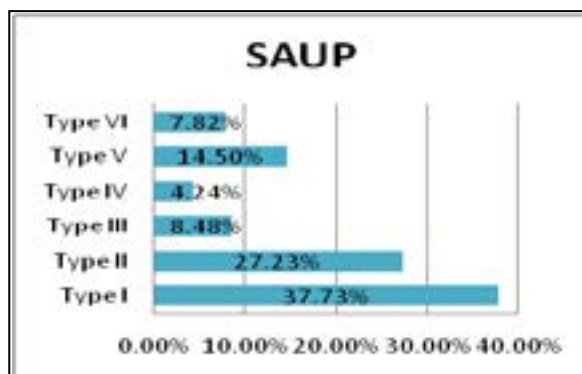


Figure 2: Variations in the superior attachment of the UP

Table 1: Baseline characteristics of the population studied

Sex	Number of cases (n=240)	Percentage (%)
Male	132	55
Female	108	45

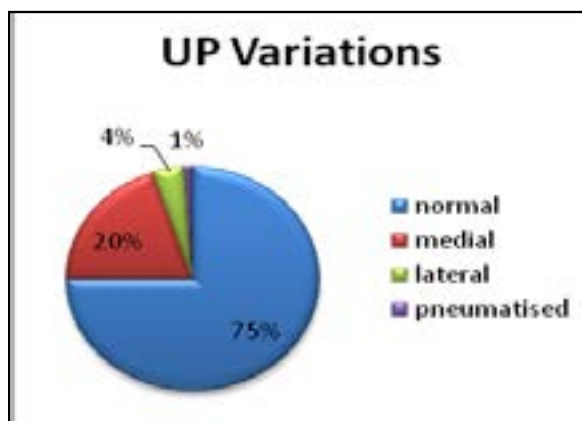


Figure 3: Variations in angulation of UP

DISCUSSION

Uncinate process (UP) is one of the important parts of the anterior OMC (Osteo Meatal Complex), responsible for the drainage of the frontal sinus, maxillary sinuses and anterior ethmoid air cells and bears a protective role in ventilation, as it enables only sterilized expiratory air to reach the sinuses. [7-9] Functional endoscopic sinus surgery (FESS) is a type of paranasal sinus surgery performed intranasally using a rigid endoscope with its objective being to restore physiological ventilation and mucociliary transport.[10] A presurgical CT is the modality of choice and is now mandatory for sinonasal surgery planning with the interest of minimizing potential complications. Uncinectomy is a mandatory step during functional endoscopic sinus surgery (FESS), to expose the maxillary ostium, hiatus semilunaris, and nasofrontal recess. [6, 11]

Preoperative detection of anatomic variations of the uncinete in the CT scan of paranasal sinuses (PNS) helps avoid intraoperative damage to the nasolacrimal duct, medial orbital wall, sphenopalatine artery, and anterior skull base, and therefore it is important surgically. [12,13]

The frontal sinus drainage pathway is dependent upon the superior attachment of the uncinete process (SAUP). The size of the frontal sinus ostium and the dimensions of the frontal beak is dependent upon the variations of the SAUP. [14] Thus for the surgeon to gain sufficient exposure to the frontal sinus by opening up the frontal recess, he has to be familiar with the anatomical variations of the uncinete process. [6]

Landsberg and Friedman found the frequency of SAUP to the lamina papyracea (TypeI) in 52.0%, to the posteromedial aspect of the agger nasi cell (TypeII) in 18.5%, to the lamina papyracea and the area where the middle turbinate joins the cribriform plate (TypeIII) 17.5%, to the area where the middle turbinate

and cribriform plate join (Type IV) 7%, to the skull base (Type V) in 3.6%; and to the middle turbinate (Type VI) in 1.4%,

Turgut et al. reported Types I and II uncinete process attachment to be 63%, Type III to be 3%, Type IV to be 12%, Type V to be 14%, and Type VI to be 8%. In a study conducted by Tuli et al., and Min et al., lateral attachment of the uncinete process (Type I) was most common, that is, 79.8 and 54% respectively, followed by attachment to the skull base (Type V), that is, 16.67 and 24.5% respectively. [5,6,15,16] Our study also showed similar frequency as 37.73%, 27.23%, 8.48%, 4.24%, 14.50% and 7.82% for the six types of SAUP respectively. The commonest SAUP was found to be to the lamina papyracea 37.73%, which was by most of the literature published.

Typical UP was taken to be a thin hook-like structure with a near sagittal orientation, which was found to be the most common type (75%). Our study found the prevalence of medially deviated uncinete process to be 20 %, lateral deviation of uncinete process in 3.96 % and pneumatized uncinete in 1.04%, which is comparable to a study by Srivastava et al. which showed the prevalence of 18.8%, 2.3% and 1.6% for medial and lateral bent and pneumatized uncinete process respectively.[17] A medially bent uncinete process with contact to the middle turbinate is one of the most frequent pathological findings in patients with chronic rhinosinusitis whereas a laterally bent uncinete process tends to obstruct the infundibulum and/or semilunar hiatus.[18] Pneumatization of the uncinete process is a rare variation with a reported prevalence of 0.4 to 13% which can cause narrowing of the hiatus semilunaris and the ethmoid infundibulum and also act as a predisposing factor for impaired ventilation of the anterior group of sinuses and frontal sinus. [19] Studies conducted by Bolger et al. and Arslan et al. reported pneumatization of uncinete to be 2.5% and 4% respectively which is similar to our result

which shows a 1.04% prevalence. [20,21]

CONCLUSION

Uncinate process in the landmark in any FESS surgery. It can have variations in its superior attachment and can have variations in its orientation or it could be pneumatized. The knowledge of its variations by pre-FESS computed tomography (CT) goes a long way in guiding the surgeon as to the approach to surgery to avoid any inadvertent injury to the nearby structures.

LIMITATION

It is a single-centre study therefore generalization is not possible to the entire population which bears so many ethnic variations.

CONFLICT OF INTEREST

None

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None

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