

Original Research Article

Anatomical variations in superior attachment of uncinat process and localization of frontal sinus outflow tract

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ABSTRACT

Background: Uncinate process (UP) is a part of ethmoid bone, which is a thin sickle shaped projection on the lateral wall of nose. UP extends from the frontal recess superiorly and inferiorly to the ethmoid process of inferior turbinate. Various studies have shown that superior attachment of uncinat process (SAUP) is the key to frontal recess region in endoscopic sinus surgeries (ESS). But these studies have yielded conflicting results, showing multiple patterns and classifications of superior attachment of uncinat process. Knowing the anatomic variations of SAUP will help the surgeon to plan the endoscopic sinus surgery and to avoid the unwanted complications. Hence this study was conducted to observe and classify the superior attachment of uncinat process and to localize the frontal sinus outflow tract.

Methods: We did a retrospective cross sectional study, consisting of 100 patients including both sexes, above the age of 10 years. We excluded pregnant ladies, patients with prior sinus surgeries, sinonasal tumours, nasal polyposis, and craniofacial trauma.

Results: We observed Type I SAUP, in 67.5% (n=135) cases, Type II SAUP in 18.5% (n=37), Type III attachment in 9.5% (n =19) and Type IV in 4.5% (n=9). Bilaterally similar attachments observed in 96% cases. Rest of the cases (4%), the attachment patterns was varying between sides.

Conclusions: The site of SAUP is highly variable. The most common type of SAUP is Type I (67.5%) followed by Type II (18.5%), Type III (9.5%) and Type IV (4.5%).

Keywords: Frontal recess, Uncinate process, FESS, OMC, Sinusitis

INTRODUCTION

Uncinate process (UP) is a part of ethmoid bone, which is a thin sickle shaped projection on the lateral wall of nose. UP extends from the frontal recess superiorly and inferiorly to the ethmoid process of inferior turbinate. Between the free edge of the UP medially and the anterior surface of bulla ethmoidalis (BE) posterosuperiorly, is a two dimensional crescentic space called hiatus semilunaris inferioris, which continues laterally as a three dimensional space (gutter), the

infundibulum.¹ The natural ostium of maxillary sinus opens into the infundibulum.

The frontal recess is a three-dimensional space connecting the frontal sinus superiorly with the nasal cavity inferiorly. The anterior wall of frontal recess is formed by a thick bone, the frontal process of maxilla, called as frontal beak (FB), agger nasi (AN). The posterior wall is formed by the anterosuperior wall of bulla ethmoidalis. The lateral wall is formed by lamina papyracea (LP) and the medial wall formed by olfactory

fossa. Component of medial and lateral wall vary based on the superior attachment of uncinat process (SAUP).² Based on the SAUP, the frontal sinus outflow is of two types – medial to UP and lateral to UP.³

Various studies have shown that superior attachment of uncinat process is the key to frontal recess region in endoscopic sinus surgeries (ESS).^{3,4} But these studies have yielded conflicting results, showing multiple patterns and classifications of superior attachment of uncinat process. Hence this study was conducted to observe and classify the superior attachment of uncinat process and to localize the frontal sinus outflow tract.

METHODS

This was a retrospective cross sectional study consisting of 100 patients including both sexes, who were referred for CT scan of head and neck region from the department of otorhinolaryngology and ophthalmology. The data was collected from the department of radio diagnosis at Sri Siddhartha Medical College, Tumukuru during the period between May 2016 and November 2016.

All patients with history of sinusitis, sinonasal surgeries, craniofacial trauma, sinonasal tumours, and nasal polyposis were excluded from the sample. Patients younger than 10 years were excluded from the study because according to Duque CS the frontal sinuses will attain an adult configuration by the age of 8 -10 years only.⁵

CT scan was done using a single “GE Singe slice spiral CT Machine” with optimal exposure settings of 125 kVp and 80 – 160 mAs. The images were obtained in coronal and axial sections with a 0.6mm thickness. Anatomical variations of frontal recess and UP were studied using both soft part window and bony density window.

The anatomical variations of SAUP were classified as

- Type I – Insertion of UP into LP directly/ indirectly (via an anterior ethmoidal cell)
- Type II –Insertion of UP into the skull base (SB)
- Type III – Insertion of UP into middle turbinate
- Type IV – UP lying free in the middle meatus (Free type).

RESULTS

A total of 100 (200 sides) CT scans of nose and paranasal sinuses were reviewed. Among them 61 were males and 39 were females, age ranging between 19-65 years (mean±SD, 36.4±3.2 years).

In our study, the most common pattern of SAUP was Type I, accounts for 67.5% (n=135) cases. Type II SAUP was the second most common, observed in 18.5% (n=37). Type III attachment in 9.5% (n=19) and Type IV in 4.5% (n=9). We observed bilaterally similar attachments in 96%. Rest of the cases (4%), the attachment patterns were varying between sides. These observations are tabulated in Table 1.

Table 1: Percentage distribution of SAUP.

Attachment type	No of cases (n=200)			Percentage
	Left	Right	Bilateral	
Type I	2	1	66	67.5%
Type II	1	2	17	18.5%
Type III	1	-	9	9.5%
Type IV	-	1	4	4.5%

The most common outflow pattern of frontal sinus tract was medial to uncinat process (72%), i.e. opening into middle meatus. In 28% of cases, the drainage was lateral to uncinat process, i.e. into the infundibulum.

DISCUSSION

The last three decades has seen a great progress in endoscopic sinus surgeries (ESS) and is accepted as the treatment of choice for chronic rhinosinusitis, not responding to maximal medical therapy.⁶ But the frontal sinus and the recess still remains as challenge for the surgeons because of its complex, unpredictable and confusing anatomy.^{5,7,8} The pneumatization pattern of the anterior ethmoidal cells and the surrounding bony plates determines the limits, shape and width of frontal recess.⁹ Among the bony plates, the superior attachment of uncinat process is the most important.¹⁰

Stamberger and Hawke in 1991 first classified the superior attachment of uncinat process into three patterns, i.e. to lamina papyracea, skull base and middle turbinate.⁴ In 2001, Landsberg and Friedman classified the superior attachment into six patterns.³ In the present study, SAUP was studied based on Stamberger and Hawke’s classification.

Out of 200 sides studied, the most common pattern of SAUP was to the lamina papyracea, i.e. Type I (67.5%, n=135). This was similar to that of Turgut et al (63%) and Netto et al (63.5%).^{11,12} But the incidence of Type I was lower than that reported by Tuli et al (79.8%).¹³ Second most common pattern was type II, observed in 18.5% (n=37) cases. This result was closer to that of Tuli et al (16.67%). Type III and Type IV was seen 9.5% (n=19) and 4.5% (n=9) respectively. Free type (Type IV) SAUP was reported in only very few studies. Our finding was

lower than that reported by Kumar et al (11%). All studies have reported, Type I as the most common pattern (>50%) followed by Type II and III.¹⁴

Few studies have reported pneumatisation of uncinate process (uncinate bulla), with an incidence ranging from 0.4 to 4%.¹⁴ In our study, we have found 4 sides with pneumatised uncinate process.

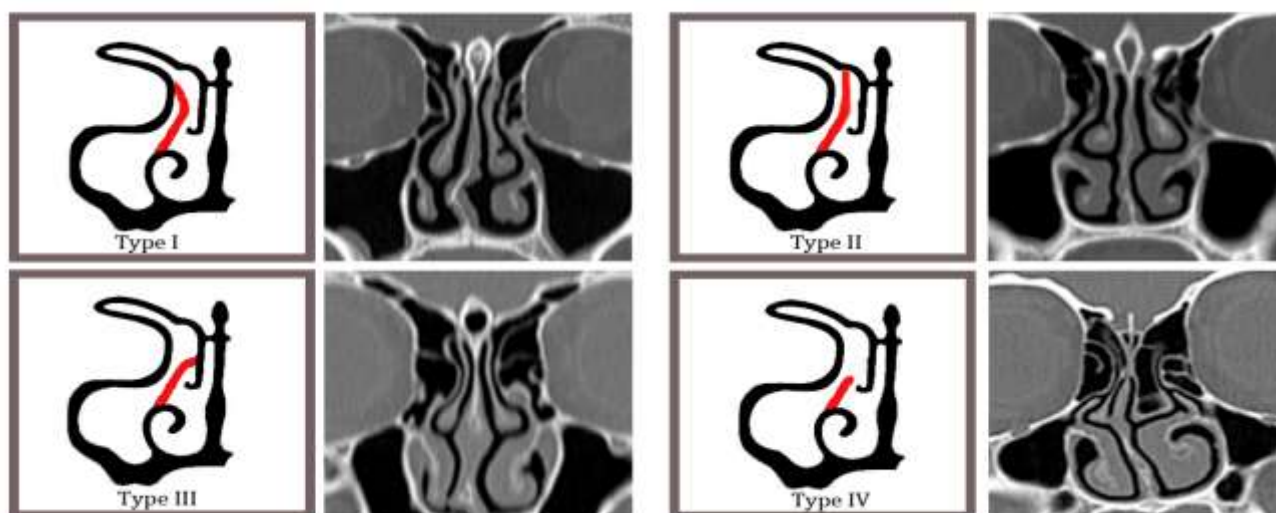


Figure 1: Schematic diagram and CT images of 4 types of superior attachments of right uncinate process.

Table 2: Variation in SAUP among different populations.

Year	Author's	Type I	Type II	Type III	Type IV
2001	Landsberg et al ³	60.5%	3.6%	1.4%	-
2005	Turget et al ¹¹	63%	14%	8%	-
2013	Tuli et al ¹³	79.8%	16.67%	3.57%	-
2015	Netto et al ¹²	63.5%	6.3%	6.3%	-
2015	Kumar et al ¹⁴	55%	8%	20%	11%
2016	Present study	67.5%	18.5%	9.5%	4.5%

Landsberg and Friedman classified the frontal sinus outflow into two types based on the SAUP, i.e. medial to UP or lateral to UP.³ In case of Type I SAUP, the frontal outflow is directly into the middle meatus. This is the most common type of frontal sinus outflow tract (72%). In such cases ethmoidal infundibulum terminates superiorly as a blind pouch called recessus terminalis.⁷ In Type II and III, the outflow tract is lateral to uncinate process and frontal recess drains via ethmoidal infundibulum into middle meatus (28%).

Endoscopic sinus surgeries start with an uncinectomy as the first step. A poorly performed uncinectomy can result in failure of the entire procedure and may leads to orbital and lacrimal complications.¹⁵⁻¹⁷ Hence it is mandatory for the operating surgeon to know about the normal anatomy and the variations of uncinate process. The most important variation seen in uncinate process is with regarding to its superior attachment.

Limitations of our study

There are still many deficiencies in our knowledge of anatomical variations of uncinate process and its role in

pathogenesis of chronic rhinosinusitis. The factors causing the variations in SAUP are not yet clearly understood. Further studies are needed to identify these factors causing and their significance in causing chronic rhinosinusitis.

CONCLUSION

The inferior attachment of UP is easily recognizable and is clearly visible even with a 0⁰ Hopkins nasal endoscope. But the superior attachment of uncinate process is difficult to visualize either via endoscope or with a tomogram. Knowing the anatomic variations of SAUP will help the surgeon to plan the endoscopic sinus surgery and to avoid the unwanted complications.

The SAUP shows multiple variations. The most common type of insertion of superior part of UP is to Lamina papyracea (Type I) as observed in 67.5% cases. There exists no consensus between the existing classification systems of SAUP. We propose to have a standardised classification of SAUP for the better knowledge of anatomical and clinical importance of uncinate process. As in previous studies, middle meatus (medial to UP) was

the most common drainage site for the frontal sinus outflow.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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