

Original Research Article

“Anatomical variations of uncinat process in a tertiary care hospital of a coastal city in Karnataka

Running title-Anatomical variations of uncinat process

Abstract

INTRODUCTION:

Superior attachment of uncinat process is the most important anatomical landmark in frontal recess surgery. The uncinat process is an integral structure of osteomeatal complex and prevents the direct contact of the inspired air with the maxillary sinus. It acts as a shield and also plays a role in muco-ciliary activity.

Anatomic variations of the uncinat process have surgical implications.

AIM:

This study was done to know the different variations of superior attachment of uncinat process.

MATERIALS AND METHODS

In this retrospective observational descriptive study, Computed Tomography (CT) scans of Para Nasal Sinuses (PNS) of 256 patients from Sept 2018 to May 2020 were studied. The results were expressed in percentages and proportions.

RESULTS

Among 256 CT images, 139 belonged to males and 117 females. In the CT films examined, on the right side, the most common attachment of uncinat was to lamina papyracea which was (64.8%) followed by skull base (19.5%) and to the middle turbinate(15.6%). Similar findings were seen on left side.

CONCLUSION

Uncinat process shows different variations in its superior attachment. Superior attachment to lamina papyracea was the most common attachment of uncinat in our study.

KEY WORDS

Uncinate process, skull base, middle turbinate, lamina papyracea

Introduction

Blumenbach first identified uncinat process in 1790.(1) It is sickle shaped, sagittally oriented and runs from anterosuperior to posteroinferiorly in the ethmoid labyrinth. Its posterior border is bulla ethmoidalis. Anteriorly the uncinat lies along the nasal wall (lateral), can reach as far as lacrimal bone. It terminates by reaching the ethmoidal part of inferior concha inferiorly. Superiorly uncinat is hidden by middle turbinate. The relationship of the ethmoidal infundibulum to skull base and frontal recess varies subject to the attachment of uncinat superiorly. (2)

The vital anatomical landmark in frontal recess operation is the attachment of uncinat superiorly. Frontal sinus surgery has always been challenging to ENT surgeons due to its anatomy.(3) The anatomy of frontal sinus always varies with its adjacent structures such as uncinat and agger nasi, and similarly its proximity to important structures. The superior attachment of uncinat process is always variable. (4)

The hiatus semilunaris inferioris is a 2 D crescentic area that lies between the free edge of uncinat (medially) and bulla ethmoidalis (postero-superiorly). It extends laterally into the 3D area termed as infundibulum. Natural ostium of maxillary sinus opens into the infundibulum. (3)

Uncinat is a vital structure in the osteomeatal complex which prevents the up-front contact of maxillary sinus with the inspired air. It also has a vital function in mucociliary clearance. It

protects the sinuses from microbes and allergens, by averting the contaminated air from going to the sinuses. (4)

The location of the attachment of uncinata superiorly has been originally recommended in 1991 by Stammberger along with Hawke. The attachment of uncinata superiorly might be due to lateral or medial bending of uncinata or its superior extension to the base of the skull. (5)

The knowledge of anatomic variants of the uncinata pre-operatively has surgical significance. It prevents injury to the nasolacrimal duct, medial orbital wall, sphenopalatine artery, etc. during surgery.(6)

Our study was done to know the several variants of uncinata process attachment superiorly.

MATERIALS AND METHODS

In this retrospective observational descriptive study, 256 CT PNS records from September 2018 to May 2020 were studied. CT scans were done using a GE bright speed 16 slice CT machine with optimal exposure settings of 120KV and 150mAS. Slice thickness was 2.5mm which was reconstructed to 1.25mm. All the CT scans were assessed in coronal plane, axial plane as well as in sagittal plane. The patient was positioned prone with the neck extension.

Patients with Malignancy of nose and paranasal sinuses, and revision nasal surgery were excluded.

After obtaining permission from the Hospital Administrator and Medical Superintendent, the CT films of patients were collected and data were extracted using a pre validated checklist

and each CT film was analyzed by a group of 3 people - consisting of one Radiologist and two Otorhinolaryngologists

The results were expressed in percentages, proportions and means with standard deviation.

Ethics approval and waiver of consent were obtained from the Institution Ethics Committee.

The patients' data were kept completely confidential and the personal identifiers were never revealed in any form while entering or reporting the results.

RESULTS

Among 256 CT images, 139 belonged to males and 117 were females. In the CT films examined, on the right side, the very frequent attachment of the uncinat process was to lamina papyracea 64.8%, followed by skull base 19.5% and to the middle turbinate 15.6%. Similar findings were seen on the left side in the CT films. The most common attachment of uncinat process to lamina papyracea 69.5%, skull base 18.4% and middle turbinate 11.3% respectively was seen on the left side in the CT films. On the left side uncinat process was found to be attached to two anatomical structures, in one scan to lamina papyracea as well as to the base of skull, and in another to middle turbinate and lamina papyracea.

Table 1. Categorizing of attachment of uncinat process superiorly

SIDE	TYPE I	TYPE II	TYPE III	OTHERS
RIGHT n(%)	166(64.8%)	50(19.5%)	40(15.6%)	0(0%)
LEFT n(%)	178(69.50%)	47(18.4%)	29(11.3%)	2(0.8%)
TOTAL N(%)	344(67.19%)	97(18.94%)	69(13.48%)	2(0.004%)

Discussion

Osteomeatal complex is a crucial area in the lateral wall. (7) Osteomeatal complex remains the final shared path of drainage of frontal sinus, maxillary sinus and anterior ethmoidal sinuses.(9)

Most common anatomical variation of osteomeatal complex are seen with the uncinat process. It is a vital milestone in Functional Endoscopic Sinus Surgery, and it is removed foremost during surgery. Pre-operative observation of uncinat process helps to prevent intraoperative complications such as injury to nasolacrimal duct, medial orbital wall and sphenopalatine artery. (6)

The attachment of uncinat superiorly has been an interesting subject from the beginning. Many prospective as well as retrospective studies have been done to know the different attachments of uncinat process. Stammberger proposed three possible variations. (8) Landsberg and Friedman proposed six types of variations of uncinat superior attachment. a.

Type I - Insertion into lamina papyracea b. Type II - Insertion into posteromedial wall of agger nasi c. Type III - Insertion into both lamina papyracea and the junction of the middle turbinate with the lamina papyracea d. Type IV - Insertion to the junction of middle turbinate with the lamina papyracea e. Type V - Insertion to the base of skull f. Type VI - Insertion to middle turbinate.

In this study, we aimed at studying the attachment of uncinata superiorly by Stammberger's classification. The most common attachment was to lamina papyracea followed by skull base and middle turbinate. Similar findings were observed by Srivastav et al, Tuli et al, Arun G et al and Landsberg et al.(5,6,3,9) The superior attachment of uncinata process to the lamina papyracea changes the drainage of the frontal sinus. This might be associated to frontal sinusitis.

Canopolat S et al also observed that the most common superior attachment of uncinata process was to lamina papyracea, although they followed a different classification. This study proved no association between uncinata superior attachment and pneumatization of agger nasi. (2)

Our study showed more than one attachment in two CT films, one to base of skull and lamina papyracea, and other to the middle turbinate and lamina papyracea, similar attachments were seen in Landsberg's study. (9)

Kumar NV et al in their study found that one more variant was visualized and named as blunt variant. (10)

One more study (Gungor G et al) emphasized the importance of uncinata, its association with osteomeatal unit by CT findings, and also discussed regarding the attachment of uncinata

superiorly and uncinata variants, such as bifid uncinata process, uncinata pneumatization and deviation of uncinata. (4)

Leyla Kansu et al studied 727 study participants. Most common pattern as per the Landsberg classification was type II (400 sides - 27.6%) followed by type I (288 sides - 19.8%), IV (224 sides -15.4%), III (212 sides - 14.5%), V (174 sides - 12.0%) and VI (132 sides - 9%) (11)

Turgut et al also followed Landsberg's classification and observed that the very frequent attachment of uncinata was to lamina papyracea followed by skull base. The prevalence of an identical pattern of superior attachment of uncinata was 23% (28 patients in 56 sides) and non- identical was 14% (9 patients in 18 sides).

If uncinata attaches to lamina papyracea then the ethmoid infundibulum gets sealed above and forms a recess termed as terminal recess. (12)

Table 2. Comparison of attachment of uncinata superiorly across various studies

Author	Type I Lamina Papyracea	Type II Skull base	Type III Middle turbinate
Mohit Srivastva	57.8%	20.3%	6.2%
Tuli	79.8%	16.67%	3.57%
Arun G	67.5%	18.5%	9.5%
Kruzeski	17.83%	33.12%	14.33%
Min	54 %	24.5%	21.5%

Landsberg	52%	3.6%	1.4%
Present study	67.2%	18.9%	13.5%

The strength of the study was that all the CT PNS scans were studied and analysed by three specialists together to reduce the observer bias.

Conclusion

Evaluation of CT PNS preoperatively showed different variations in the superior attachment of uncinat process. The attachment to lamina was the most frequent one but insertion into the middle turbinate and skull base were not uncommon.

REFERENCES

1. Yenigün A, Gün C, Uysal İİ, Keleş MK, Nayman A, Karabulut AK. Prevalence of pneumatized uncinat process and accompanying neighboring variations. *Kulak Burun Bogaz Ihtis Derg.* 2016;26(4):195–200.
2. Scott and Brown's Otorhinolaryngology, Head and Neck Surgery. 7th Edition. Vol. 2. Edward Arnold (Publishers) Ltd; 1315–43 p.
3. DeConde AS, Smith TL. Outcomes after Frontal Sinus Surgery: An Evidence-Based Review. *Otolaryngol Clin North Am* [Internet]. 2016 Aug [cited 2021 Nov 21];49(4):1019–33. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4964596/>
4. Canpolat S, Sayın İ, Hocaoglu E, Yazıcı ZM, Güneş S, Çelik M, et al. The relationship between the superior attachment type of the uncinat process and the objective volume of the agger nasi cell: a computer-assisted anatomic study. *B-ENT.* 2017;13(3):211–7.
5. Arun G, Moideen SP, M M, Afroze M KH, Thampy AS. Anatomical variations in superior attachment of uncinat process and localization of frontal sinus outflow tract. *Int J Otorhinolaryngol Head Neck Surg* [Internet]. 2017 Mar 25 [cited 2020 Oct 28];3(2):176. Available from: <http://www.ijorl.com/index.php/ijorl/article/view/302>
6. Güngör G, Okur N, Okur E. Uncinat Process Variations and Their Relationship with Ostiomeatal Complex: A Pictorial Essay of Multidetector Computed Tomography

- (MDCT) Findings. *Pol J Radiol* [Internet]. 2016 Apr 20 [cited 2020 Oct 28];81:173–80. Available from: <http://www.polradiol.com/abstract/index/idArt/895885>
7. Srivastava M, Tyagi S. Role of Anatomic variations of Uncinate Process in Frontal Sinusitis. *Indian J Otolaryngol Head Neck Surg* [Internet]. 2016 Dec [cited 2020 Oct 28];68(4):441–4. Available from: <http://link.springer.com/10.1007/s12070-015-0932-6>
 8. Patla SDK, Rathnakar P, Bhat VS, Lnu J. A Radiological Study of Anatomical Variations of Uncinate Process. *Int J Clin Rhinol* [Internet]. 2016 Aug [cited 2020 Oct 16];9(2):59–61. Available from: <https://www.ajcr.com/doi/10.5005/jp-journals-10013-1268>
 9. Laine FJ, Smoker WR. The ostiomeatal unit and endoscopic surgery: anatomy, variations, and imaging findings in inflammatory diseases. *Am J Roentgenol* [Internet]. 1992 Oct 1 [cited 2021 Nov 21];159(4):849–57. Available from: <https://www.ajronline.org/doi/10.2214/ajr.159.4.1529853>
 10. Tuli IP, Sengupta S, Munjal S, Kesari SP, Chakraborty S. Anatomical Variations of Uncinate Process Observed in Chronic Sinusitis. *Indian J Otolaryngol Head Neck Surg*. 2013;65(2):157–61.
 11. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. *Eur Arch Otorhinolaryngol*. 1990;247:63–76.
 12. Landsberg R, Friedman M. A Computer-Assisted Anatomical Study of the Nasofrontal Region. *The Laryngoscope* [Internet]. 2001 Dec [cited 2020 Oct 16];111(12):2125–30. Available from: <http://doi.wiley.com/10.1097/00005537-200112000-00008>
 13. Kumar NV, Kamala E, Priya TSG, Kumari SDN. A computerized tomographic study of uncinat process of ethmoid bone. *Int J Anat Res* [Internet]. 2015 Mar 31 [cited 2020 Oct 16];3(1):917–21. Available from: <http://www.ijmhr.org/ijar.3.1/IJAR.2015.114.html>
 14. Kansu L. The relationship between superior attachment of the uncinat process of the ethmoid and varying paranasal sinus anatomy: an analysis using computerised tomography. *ENT Updat* [Internet]. 2019 Aug 1 [cited 2020 Oct 16]; Available from: <http://dergipark.org.tr/doi/10.32448/entupdates.595449>
 15. Turgut S, Ercan I, Sayin I, Basak M. The Relationship Between Frontal Sinusitis and Localization of the Frontal Sinus Outflow Tract: A Computer-Assisted Anatomical and Clinical Study. *Arch Otolaryngol Neck Surg* [Internet]. 2005 Jun 1 [cited 2020 Oct 16];131(6):518. Available from: <http://archotol.jamanetwork.com/article.aspx?doi=10.1001/archotol.131.6.518>

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