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A computerized tomography-based study of anatomical variations of the ethmoidal uncinate process

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ABSTRACT

Background: The uncinate process is very relevant with respect to the ventilation and drainage of the frontal, maxillary and anterior ethmoid sinuses in the osteomeatal complex. **Aims and Objectives:** The study was conducted with the aim to examine and assess various patterns of upper attachment of the ethmoidal uncinate process. The secondary objective of the study was to study the incidence of pneumatization of the uncinate process. **Materials and Methods:** With the objective to study the various patterns of upper attachment of the uncinate process, the study was conducted at the Department of Ear, Nose, and Throat (ENT) Head and Neck Surgery, at Government Medical College, Doda, J and K, India. The period of study was from November 2020 up to November 2021. The study involved 100 patients who had presented to the ENT outpatient with nasal and or sinus-related complaints. **Results:** The study included 58 males and 42 females. Among the various patterns, it was the type-2 pattern of the uncinate attachment that was the most prevalent (42%). This was followed by a type-1 pattern (attached to the lamina papyracea) (16%) and then a type-6 pattern (14%). Type-3 in 4%, type-4 in 3%, and type-5 in 7%. In 14% of the cases, there was no upper attachment of the uncinate process. The pneumatization of the uncinate process was noted among 42 of the uncinate processes that we studied. The pneumatization was unilateral in 41% and bilateral in 59% of the uncinate process. The patients with a pneumatized uncinate process had more severe clinical presentation. **Conclusions:** A thorough computerized tomography scan assessment of the attachments of the uncinate process and its variations aids in minimizing damage to the related landmarks during the surgery and helps minimizing the chances of iatrogenic trauma to the nasolacrimal duct, medial orbital wall, and other surrounding structures. It can also assist in figuring out the likely cause of refractory sinusitis.

Key words: Uncinate process; Chronic rhinosinusitis; Osteomeatal complex; Functional endoscopic sinus surgery

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INTRODUCTION

While it is beyond doubt that the advent of nasal endoscopes and computerized tomography (CT) has revolutionized not just the treatment protocols of sinus pathologies, but it has also brought about an exemplary enhancement in our understanding of the intricate anatomy of the paranasal sinuses and their drainage and ventilation aspects.

The osteomeatal complex is housed in the lateral nasal wall in the middle meatal region. The bulla ethmoidalis and the uncinate process are the constant anatomical landmarks in this complex. The uncinate process presents itself as a projection emanating from the ethmoid labyrinth. Upon its inferior aspect, it attaches to the inferior turbinate's ethmoidal process.[1]

The uncinate process is very pertinent with respect to the ventilation and drainage of the frontal, maxillary and

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anterior ethmoid sinuses in the osteomeatal complex. It has to be borne in mind that the superior attachment of the uncinate process is not constant. Many authors have reported varying patterns of superior attachments. Furthermore, while operating the superior most limit of the unicinate process is oblivious to the surgeon, since it remains hidden by the middle turbinate.[2]

Landsberg and Friedman in their study had reported six patterns of upper attachment of uncinate process Type 1: Attached to the lamina papyracea. Type 2: Attached to the posterior agger nasi cell. Type 3: Attachment to the lamina papyracea and junction of the middle turbinate with the cribriform plate. Type 4: Attachment to junction of the middle turbinate with the cribriform plate. Type 5: Attached to the ethmoid skull base. Type 6: Attached to the middle turbinate.[3]

Landsberg and Friedman's patterns of attachment of uncinate process
Type 1: Attached to the lamina papyracea
Type 2: Attached to the posterior agger nasi cell
Type 3: Attachment to the lamina papyracea and junction of the middle turbinate with the cribriform plate
Type 4: Attachment to junction of the middle turbinate with the cribriform plate
Type 5: Attached to the ethmoid skull base
Type 6: Attached to the middle turbinate

Stummberger proposed only 3 types, whereby the uncinate process was inserted superiorly into lamina papyracea or ethmoid skull base or the middle concha.

Osteomeatal region also addressed as the key area, often displays variations in its anatomy. With resulting impaired ventilation and blockage of mucus drainage leading to chronic rhinosinusitis. Deviation in the upper attachment of the uncinate process that impairs ventilation of the anterior ethmoid and frontal sinus is a possibility that could hasten and abet a chronic disease process.[4] Some studies proposed that the uncinate process probably prevented direct ventilation of sinuses with contaminated inhaled air.[1,5,6]

The effect of upper insertion of uncinate process contributing to sinonasal pathologies is a subject of debate. Keeping these aspects in mind it was decided to study the upper insertion of the uncinate process and also the presence of pneumatization in the uncinate process, based on CT of the nose and the paranasal sinuses.

Aims and objectives

The study was conducted with the aim to examine and assess various patterns of upper attachment of the ethmoidal uncinate process. The secondary objective of the study was to study the incidence of pneumatization of the uncinate process.

MATERIALS AND METHODS

The study was conducted at the department of ear, nose, and throat (ENT) head and neck surgery, at Government Medical College, Doda, J and K, India. This was a retrospective observational study. The period of study was from November 2020 up to November 2021. The study involved 100 patients who had presented to the ENT outpatient with nasal and or sinus-related complaints. After a thorough clinical examination and diagnostic nasal endoscopy, the study group was advised to do a CT of the nose and paranasal sinuses. This included 3 mm coronal as well as axial cuts. The CT films of the nose and paranasal sinuses were thoroughly examined with the area of interest being the uncinate process, its insertion, and also the coexisting sinonasal pathologies.

The inclusion criterion in patients with sinonasal disease and consenting to be part of the study group. The patients with a previous history of nasal surgeries were excluded from our study. Those unwilling to be part of our study were also excluded from the study group.

The coronal cuts' films were used to evaluate the attachment of the uncinate process. The attachment was documented and classified as per Landsberg and Friedman. The study was conducted after the nod from our college's ethics committee.

RESULTS

The study included 58 males and 42 females (Figure 1). All the patients belonged to the age group ranging from 15 up to 65 years. The majority (83) of the patients belonged to the 20–45 years age group (Figure 2).

Since we had included 100 patients in our study, therefore we evaluated the upper insertion of 200 uncinate processes.

This was documented and duly classified as per Landsberg and Friedman. Among the various patterns we noticed in our study, it was the type-2 pattern of uncinate attachment that was the most prevalent (42%). This was followed by a type-1 pattern (attached to the lamina papyracea) (16%) and then a type-6 pattern (14%). Type-3 in 4%, type-4 in 3% and type-5 in 7%. We also noted that in 14% of the cases, there was no upper attachment of the uncinate process (Figure 3).

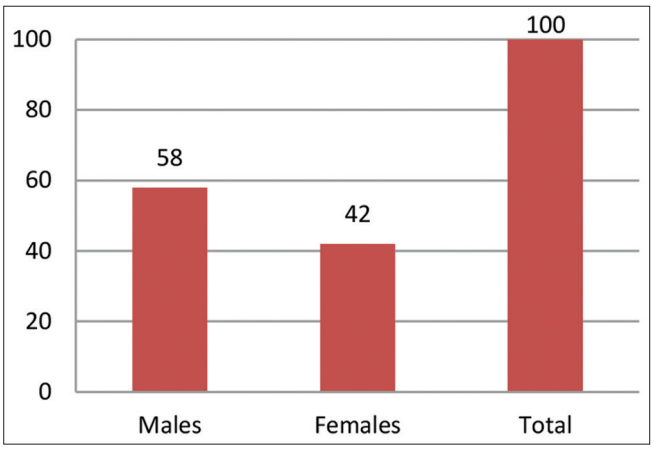

Figure 1: Graph showing the gender distribution.

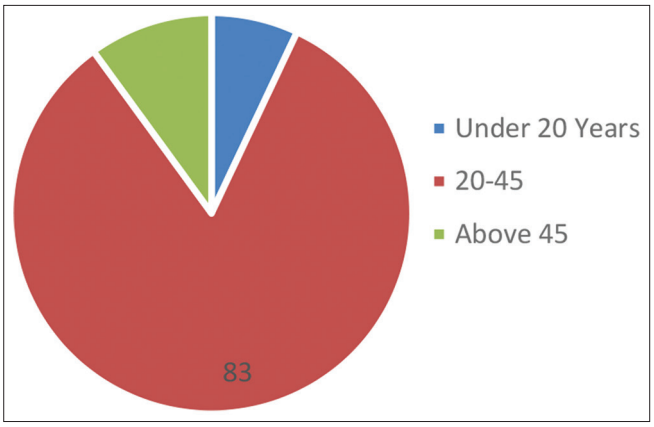

Figure 2: Graph showing age distribution.

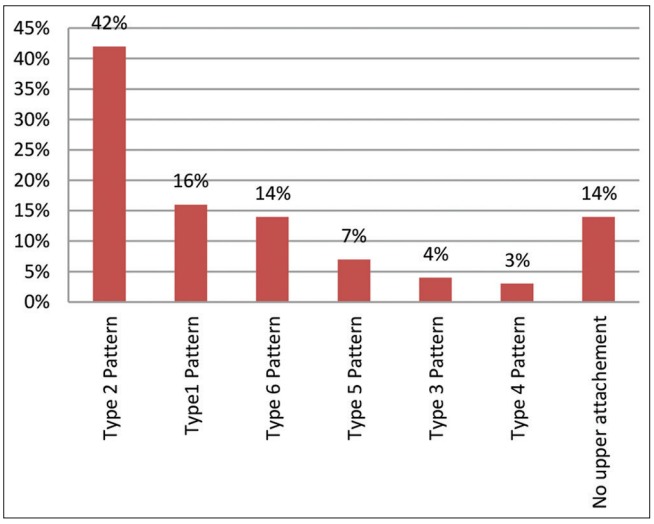

Figure 3: Graph showing the various types of uncinate attachment in our study

The pneumatization of the uncinate process was noted among 42 of the uncinate processes that we studied. The pneumatization was unilateral in 41% and bilateral in 59% of the uncinate processes that were studied by us. We also observed that the patients in our study with a pneumatized uncinate process had a more severe clinical presentation.

DISCUSSION

The uncinate process is postulated to play a conspicuous functional role in the ventilation of the nose and the paranasal sinuses and it's not just a vestigial structure.[7] The upper insertion of the uncinate process has been observed and reported in very less research publications. In our research, we also observed that there was also a blunt uncinate without any upper insertion. The incidence and pattern of upper insertion of the uncinate process were also compared to the patterns in previous studies.[8-12]

Among the various patterns we noticed in our study, it was the type-2 pattern of uncinate attachment that was the most prevalent (42%) (Figure 8). This was followed by a type-1 pattern (attached to the lamina papyracea) (16%) and then a type-6 pattern (14%). Type-3 in 4%, type-4 in 3% (Figure 7) and type-5 in 7%. We also noted that in 14% of the cases (Figure 9), there was no upper attachment of the uncinate process. Turgut et al.,[8] (Figure 10) reported 63% type-1 and type-2 attachments, 3% type-3, 12% type-4, 14% type-5, and 8% type-6 attachments (Figure 4).

Similarly, Tuli et al.,[9] reported 79.8% type-1 attachments, 16.67% type-5, and 3.57% type-6 attachments (Figure 5). In another research work, Krzeski et al.,[10] reported 17.83% type-1 attachments, 33.12% type-5, and 14.33% type-6 attachments.

Min et al.,[11] in their study reported 54% type-1 attachments, 24.5% type-5, and 21.5% type-6 attachments (Figure 5).

Vinay Kumar et al.,[12] reported 19% type-1 and 36% type-2 attachments, 5% type-3, 2% type-4, 8% type-5, and 20% type-6 attachments (Figure 6). They also reported 11% blunt uncinate processes.

A pneumatized uncinate process in various studies has been reported as 0.4–4%. However, some have reported 0.5–2.5% extensively pneumatized uncinate describing it as uncinate bulla.[5,9,10,13] Bolger et al., in their study, reported that the anterosuperior region was the predominant aspect for pneumatization.[5]

It has been postulated that uncinate pneumatization was an outcome of the growth of agger nasi cells into the most anterosuperior portion of uncinate.[14] Since, the incidence in our study is higher, this warrants a more exhaustive study and also its relation with the incidence of sinonasal pathologies.

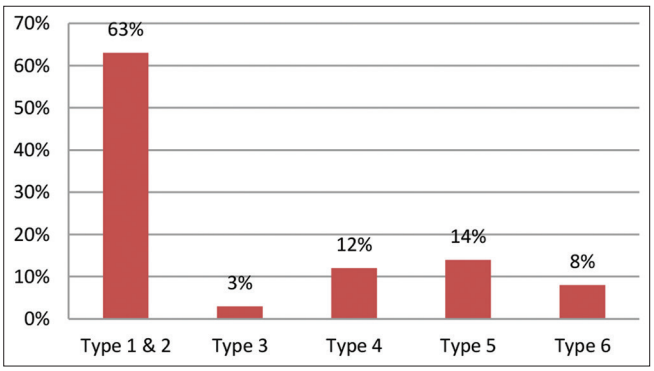

Figure 4: Graph showing the various types of uncinate attachment in study by Turgut *et al*

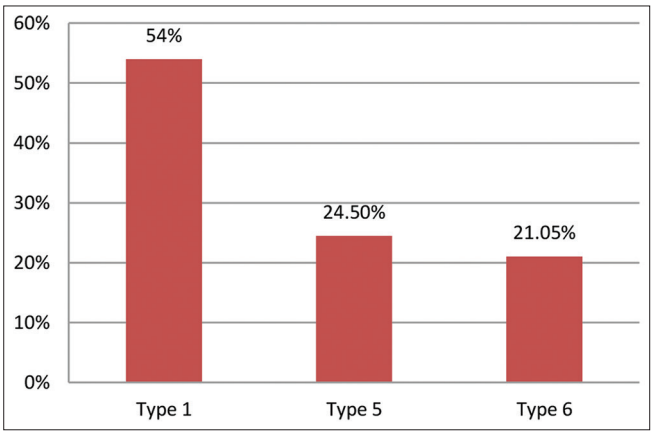

Figure 5: Graph showing the various types of unciante attachment in study by Tuli *et al*

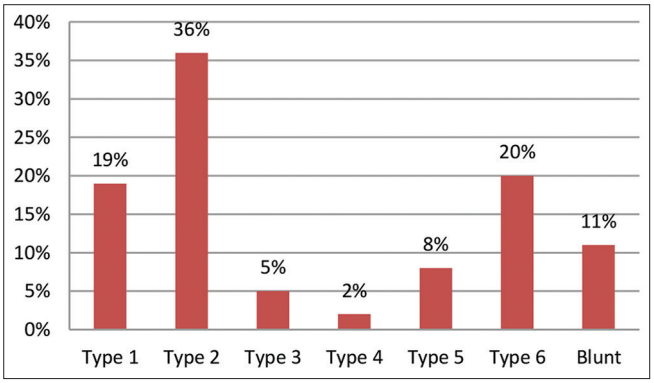

Figure 6: Graph showing the various types of unciante attachment in study by Vinay Kumar *et al*

Some researchers have also highlighted medial and lateral deviations of uncinate process resulting in a shallow infundibulum, frontal, and anterior ethmoidal recess compromising the sinus ventilation in maxillary, frontal, and ethmoid sinuses.[14-16]

Few research works have also proclaimed that deviations of the uncinate process prevent contaminated air from entering the sinuses.[1,5,6] Thus questioning the injudicious removal of the uncinate during endoscopic sinus surgery.

Figure 7: Type-1 insertion

Figure 8: Type-2 insertion

Figure 9: Type-4 insertion

Limitations of the study

The study involved a total of 100 patients. While it gives an important insight into different patterns of uncinate

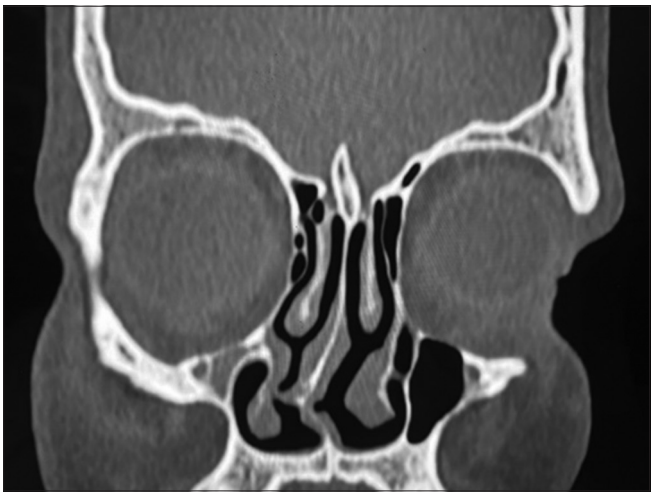

Figure 10: Type-5 insertion

attachment. However, a larger population base needs to be studied to generalize our findings.

CONCLUSION

A thorough CT scan assessment of the attachments of the uncinate process and its variations aids in minimizing damage to the related landmarks during the surgery.

A prior knowledge of variations of the uncinate process helps minimizing the chances of iatrogenic trauma to the nasolacrimal duct, medial orbital wall, and other surrounding structures.

A thorough evaluation of the pneumatization and also the upper attachment of the uncinate process can also assist in figuring out the likely cause for refractory sinusitis.

Newer emerging paradigms in the management of chronic sinusitis compel surgeons to have a thorough awareness of the key area and also the anatomical variations if any.

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Authors' Contribution:
RS- Review of literature, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article, concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **PG-** Review of literature, data analysis, concept, design.

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