ORIGINAL RESEARCH

Anatomical Variations of the Superior Attachment of the Uncinate Process in Sudanese Patients: An Imaging Study

A Mohammed[1], MAA Abdelmotalab[2], OAA Abdelaziz[1], AMA Fadol[2]

[1]Anatomy Department, Faculty of Medicine and Health Science, Omdurman Islamic University, Sudan.
[2]Anatomy Department, Faculty of Medicine, International University of Africa, Sudan.

Abstract

Objectives: The aim of this study is to evaluate the different anatomical variations of the superior attachment of the uncinate process and its shape, in brain imaging

Methods: A retrospective hospital-based study was conducted on 103 patients undergoing CT imaging of the head at *Alyamama* Specialized Hospital, Kosti City, White River Nile State from January to March 2022. A systematic random sample was collected from the hospital records using a prepared questionnaire.

Results: The age of the study group was arranged between 3 and 95 years. The superior attachment of the uncinate process was found to be symmetrical in the majority. The most common superior attachment was type 1 (lamina papyracea) in both sides in both genders (39.32%). Type 2 was at the agger nasi (3.4%). In 7.8%, uncinate process was pneumatized while in 2.9% it was bifid. One third of the sinuses showed opacities.

Conclusion: The attachment of the uncinate process in both sexes on both sides was commonly to the lamina papyrecea, with attachment to Agger-Nasi cell being the least common.

Keywords: Uncinate process; Anatomical variations; Skull osteology

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Corresponding author

A Mohammed

email: alentod@gmail.com

https://orcid.org/0009-0007-6191-493

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Introduction

The uncinate process is a Latin term, meaning hooked out growth. It is a thin bone, which has an inferior end that attaches to the inferior concha and a variable superior attachment to the lamina papyracea, skull base or the middle turbinate (1-5). The uncinate process has various physiological roles in respiration and protective function against bacteria, in addition to its essential role in functional endoscopic sinus surgery (5-7). The present-day technology of imaging such as CT scans, especially coronal view, is considered the investigation of choice as it gives details about sinuses and their anatomical variations, which enhance the approach and outcome of endoscopic sinus surgery (1, 2, 8-10).

There are many anatomical variations of the uncinate process, in particular variations in its superior attachment, bending medially or laterally and its variable shape. Its pneumatization plays a role in the patency of the osteomeatal complex and subsequent narrowing of the infundibulum, resulting in sinusitis (2, 11, 12). Several different types are mentioned in different classification systems: in which the uncinate process bends laterally to be inserted into the lamina papyracea which is the most common, which extends superiorly to the roof of the ethmoid, that is the skull base, where the superior end of the uncinate process turns medially and is attached to the middle turbinate and finally, and the free type. Other variations include pneumatized uncinate process or uncinated bulla and bifid uncinate process (2, 11).

The uncinate process has a significant role in mucociliary drainage and ventilation in addition to a protective function by filtering the inspired air before entering the sinus (13, 14). It is also an important landmark in functional endoscopic sinus surgery (FESS) and is the first structure being resected. It also gives excess to maxillary sinus, ethmoid infundibulum and the frontal sinus. Anomalies of uncinate are frequent, especially in individuals with chronic sinusitis (2, 5, 11). Most of the sinuses drain into the middle meatus into stomatal complexes. Anything hindering the ventilation leads to chronic sinusitis (9, 12, 15). Chronic sinusitis, is an inflammation of the mucosal lining of the nose and paranasal sinuses. The patient typically presents with a headache, nasal obstruction, and occasionally loss of smell (16). Imaging may detect mucosal thickening or sinus opacity and changes in bone in patients with sinusitis (17).

The pathophysiology of chronic sinusitis and its relationship with anatomical variations is still a point of argument (18, 19). Some studies suggest that the anatomical variations of the uncinate process have no relation to sinusitis despite the others demonstrating the positive impact of these variations on the disease (2, 20, 21).

Understanding the detailed anatomy and possible anatomical variations is a crucial step in success of endoscopic surgery and decreases the intraoperative complications (5, 12). The superior attachment of the uncinate process is a hidden area for surgeons and determines the final frontal sinus outflow (14, 22).

The present study aims to describe the anatomical variations of the superior attachment of the uncinate process in Sudanese patients and classify them according to the Landsberg and Friedman classification (23).

Methods

This is a retrospective hospital-based study to evaluate the anatomical variation of the superior attachment of the uncinate process in Sudanese patients. It was conducted at

Alyamama Specialized Hospital, Kosti City, White River Nile State, Sudan, during the period from January to March 2022. Approval for the study was obtained from the Ethics Committee of Omdurman Islamic University, Faculty of Medicine & Health Science and from the Hospital directors.

Images from CT scans done during the study period were extracted and evaluated with the aid of a prepared questionnaire. CT scans of the brain in coronal view were utilised. The CT scan type was Optima from General Electronic (GE) and contained 16 slides. The coronal view shows the details of the uncinate process such as its superior attachment, shape and its bipartite or pneumatic nature. The data was interpreted by Radiant Dicom Viewer (64-bit).

The superior attachment of the uncinate process is classified into six types of uncinate process according to Landsberg and Friedman: type 1: insertion to lamina panacea, type 2: insertion of posterior wall of agger nasi cell, type 3: insertion into lamina papyracea & junction of the middle turbinate with the cribriform plate, type 4: insertion to the junction of the middle turbinate with the cribriform plate type 5: insertion to the ethmoid skull base, type 6: insertion into the middle turbinate (23). The images were carefully studied and classified accordingly.

Data was analysed with the Statistical Package for Social Sciences (SPSS) 23.0. A p-value less than 0.05 was considered statistically significant.

Results

Of the 103 images utilised, 55 (53.5%) were from males and 48 (46.6%) from females, with a mean age of 42 years. In 58 (56.3%) of the images the superior attachment was bilaterally symmetrical, while in 45 images it was bilaterally asymmetrical.

Unilateral right-side attachment in 26.7% was to lamina papyracea (type 1), 1.9% to Agger nasi cell (type 2), 24.4% to lamina papyracea & junction of the middle turbinate with the cribriform plate (type 3), 13.3% were inserted to the junction of the middle turbinate with the cribriform plate (type 4), 22.2% to ethmoid skull base (type 5),11.1% to middle turbinate (type 6) and 2.2% were blunt respectively.

Unilateral left side attachment in 42.7% was to lamina papyracea (type 1), 4.9% to Agger nasi cell (type 2), 13.6% into lamina papyracea & junction of the middle turbinate with the cribriform plate (type 3), 17.5% to the junction of the middle turbinate with the cribriform plate (type 4),15.6% to ethmoid skull base (type 5), 8.7% to middle turbinate (type 6) and 2.9% was blunt respectively.

The shape of the uncinate was typical bilaterally in 84.5%, bifid bilaterally in 1.9%, pneumatized bilaterally in 1%. Pneumatized uncinate process on the left side was 6.8%, right side 1.9%.

Out of 103 patients 69, 9% of the sinus were normal. Only 31.1% had sinus opacity. A strong relationship was found between sinus opacity and the type of superior attachment on the right side with p value of 0.04, which is statistically significant.

Discussion

The findings of the current study demonstrated that the lamina papyracea (type 1) was the most common superior attachment, while the agger nasi cell (type 2) was the least common attachment. blunt type was 5.8%.

The shape of the uncinate process in the majority of patients was normal bilaterally. Small percentage was pneumatized or bifid. The bilateral symmetrical attachment, which was 56.3% and asymmetrical attachment was

46.7% in the study, agreed with a study done by Arun *et al.,* (2016) in India (3).

Most of the studies did not mention the symmetry of uncinate process attachment bilaterally in comparable literature, which is critical for surgeons to detect the difference between the two sides when performing the functional endoscopic sinus surgery. The current study showed that the commonest superior attachment (39.32%) was to Lamina panacea (type 1) in consistency similar to previous studies (2, 3, 10, 11, 13, 24). The least common attachment (3.4%) was to agger nasi (type 2); in contrast to two studies done by Kumar *et al.,* (2015) in the Indian population and Turkish study by Kansu *et al*., (2019), they reported higher percentages than the present study (4, 5). Furthermore, other types of uncinate processes (type 3, type 4, type 5, and type 6) were variable between 17.48 % to 9.22 %, close to Kansu *et al.,* (2019) (5).

In comparison the asymmetrical attachment between the right and left side, Baldea *et al.,* (2012) and Patla *et al.,* (2016) mentioned that, lamina papyracea (type 1) was the commonest attachment on both sides similar to this study (25, 26). Moreover, Baldea *et al.,* added that the higher percentage of lamina papyracea attachment on the left side was more than on the right side similar to the current (25). While, Patla *et al.,* mentioned that the right side was more common than the left side in contrast to this study. Furthermore, the attachment of the junction of the middle turbinate with the cribriform plate (type 4) was the same on both sides in the current study. Additionally, both type 3 and type 4 were higher in the present study in contrast to Patla *et al.,* (2016) (26).

Concerning the shape of the uncinate process, in the majority of patients it was normal bilaterally similar to a study by Tuli *et al.,* (11). Pneumatization of the uncinate process simply means aeration of the uncinate process, which may precipitate sinusitis. Pneumatization was low bilaterally but higher on the left side close to a Bangladesh study (13).

Regarding the sinus opacity, data was statistically significant on the right side, which may indicate there is an association between the sinus opacity and superior attachment of the uncinate process.

Conclusion

In conclusion, the most common superior attachment of uncinated process on both genders and on both sides was type 1 into lamina papyracea followed by type 4 and type 3 and the low percentage was seen for to type 2 and the blunt type. Symmetrical bilateral attachment was more common than asymmetrical attachment. Understanding of the superior attachment of the uncinate process variations is crucial for safe and effective sinus surgery, especially to avoid complications like orbital injury or cerebrospinal fluid leaks.

Conflict of interest statement: The authors declare no conflict of interest

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