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Association Between Superior Attachment of Uncinate Process and Frontal Sinusitis

Anupama Shah Rijal, [1]Abhushan Siddhi Tuladhar, [2]Rupesh Raj Joshi, [1]Kundan Kumar Shrestha, [1]Anup Dhungana[1]

[1]Department of Otorhinolaryngology, [2]Department of Radiology, Nepal Medical College and Teaching Hospital, Kathmandu University, Nepal.

ABSTRACT

Introduction

The uncinate process (UP) is a sickle shaped bone. The superior attachment of uncinate process can be into the lamina papyracea (Type I), the skull base (Type II) and the middle turbinate (Type III). Drainage of the frontal sinuses depends on the superior attachment of the UP and alterations in drainage predisposes to sinusitis. This study looked at the association between the superior attachment of UP and chronic frontal sinusitis.

Methods

A cross sectional study was conducted in the Otorhinolaryngology out-patient department. Patients were diagnosed as chronic rhinosinusitis according to the American Academy of Otolaryngology–Head and Neck Surgery Rhinosinusitis Task Force criteria. Patients then underwent a non-contrast CT scan of paranasal sinuses. Superior attachment of the UP was noted from the CT, and the association between the superior attachment of the UP and chronic frontal sinusitis was recorded.

Results

Among the 144 sides examined it was seen younger (20-29 years) female (52.8%) patients were more affected by the condition. The most common superior attachment of the UP was into the lamina papyracea being 75% and 73.6% on the right and left sides respectively. There was a significant association between the superior attachment of the uncinate process and chronic frontal sinusitis (p=0.001 and .002) on both sides.

Conclusions

Among the superior attachments of the uncinate process, attachment into the lamina papyracea was the commonest. It was noted that chronic frontal sinusitis was significantly associated with the superior attachment of the uncinate process.

Keywords: Chronic frontal sinusitis; lamina papyracea; superior attachment; uncinate process.

Correspondence: Dr. Anupama Shah Rijal, Department of Otorhinolaryngology Nepal Medical College and Teaching Hospital, Kathmandu University, Nepal. Email: asrijal@gmail.com. Phone: +977-9841906215

INTRODUCTION

The uncinate process (UP) is a sickle shaped bone, which attaches inferiorly to the inferior turbinate and palatine bone and anterosuperiorly to the lacrimal bone.[1] The superior attachment of uncinate process can be into the lamina papyracea (Type I), the skull base (Type II) and the middle turbinate (Type III).[2,3] Drainage of the frontal sinus depends on the superior attachment of the uncinate process and alteration in the drainage predisposes to frontal sinus diseases. Chronic frontal rhinosinusitis (CRS) is encountered frequently in Otorhinolaryngology. CRS can be diagnosed by using the rhinosinusitis task force criteria of American Academy of Otolaryngology–Head and Neck Surgery (AAOHNS).[4] Computed tomography (CT) currently is the gold standard imaging method to show the anatomy and pathology of paranasal sinuses.[5,6] This study was conducted with an aim to determine an association between the superior attachment of uncinate process and chronic frontal sinusitis.

METHODS

A cross sectional study was conducted at Nepal Medical College Teaching Hospital (NMCTH), Otorhinolaryngology out-patient department (OPD). The study duration was from April to September 2022. All consecutive OPD patients with nasal obstruction and discharge for more than 12 weeks, above 20 years of age and who consented were included in the study. Patients with past history of sinonasal surgery, craniofacial malformations, fractures, malignant neoplasm, fungal sinusitis, mucocele were excluded. Other variations of uncinate processes namely, pneumatised, hypertrophied, medially bent, laterally bent and unclear or multiple superior attachments were also excluded. Ethical approval was obtained from the research and institutional review committee of NMCTH prior to the study. Detailed history was taken and clinical examination of the patients were done. Patients were clinically diagnosed as chronic rhinosinusitis according to the American Academy of Otolaryngology–Head and Neck Surgery (AAOHNS) Rhinosinusitis Task Force criteria. Chronic rhinosinusitis was diagnosed by the presence of two or more major factors or one major with two minor factors. Major factors are facial pain/pressure, nasal obstruction/blockage, nasal discharge/purulence/discoloured postnasal drainage, hyposmia/anosmia, purulence in nasal cavity on examination and fever (in acute rhinosinusitis only). Minor factors are headache, fever (all non-acute), halitosis, fatigue, dental pain, cough, ear pain/pressure/fullness. Facial pain/pressure alone does not constitute a suggestive history for rhinosinusitis in the absence of another major nasal symptoms or signs. [4]Patients after being clinically diagnosed were referred to the department of Radiology for non-contrast CT scan of paranasal sinuses. Images were obtained using Toshiba, Aquilion, 64 slice multidetector CT Scanner. Multiplanar reformatted images were obtained in 3 mm axial, coronal and sagittal planes. The CT scans were studied and reported by the same radiologist. The data was recorded in the proforma, coded and analysed. Statistical analysis was done using SPSS version 16. Descriptive statistics such as frequency, mean and standard deviation was calculated. Chi-square test was used to fin d the association between the variables.

RESULTS

The study evaluated 72 patients with 144 chronic frontal sinuses. Females 38 (52.8%) were more affected than males 34 (47.2%) with the ratio 1.1:1. The age ranged from 20 years to 79 years with the mean of 38.65 years ±13.66. The maximum number of patients, 22 (30.6%) were within 20 to 29 years age group, with 12 (16.7%)

males and 10 (13.9%) females. In the other two groups of 30 to 39 years and 40 to 49 years there were 18 (25%) patients in each. In the 30 to 39 years age group there were 7 (9.7%) males and 11 (15.3%) females and in the 40 to 49 years age group there were 12 (16.7%) males and 6 (8.3%) females. The 50 to 59 years age group consisted of 8 (11.1%) patients out of which 2 (2.8%) were males and 6 (8.3%) were females. There were 6 (8.3%) patients above sixty years of age with 5 (6.9%) females and 1 male (Figure 1).

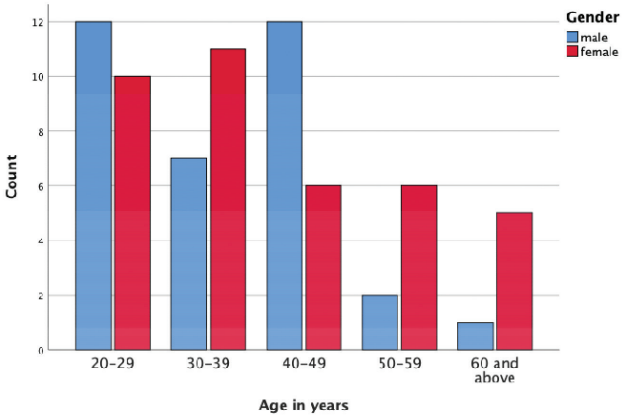

Figure 1. Distribution of age and gender.

The UP was attached into the lamina papyracea in 54 (75.0%) on the right side and 53 (73.6%) on the left side. Attachment into the skull base was seen in 13 (18.1%) on the right and 11 (15.3%) on the left side. On the right side 5 (6.9%) and on the left 8 (11.1%) were attached into the middle turbinate.The various attachments of superior part of UP in our study are shown in the CT scans below. (Figure 2), (Table1)

Overall total chronic frontal sinusitis was seen in 39 (54.2%) frontal sinuses on the right side out of which 23 (31.9%) frontal sinusitis had attachment to the lamina papyracea. Twelve (16.7.%) out of 39 showed chronic frontal sinusitis with the attachment to skull base, whereas 4 (5.6%) had sinusitis with attachment to middle turbinate. In our study on the right side there was significant association seen between the superior attachment of the UP and chronic frontal sinusitis (P=0.001). (Table 2)

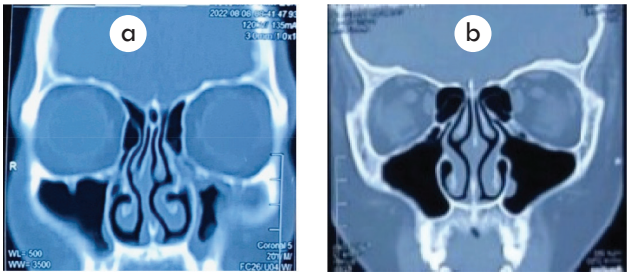

Figure 2. CT scan coronal view showing superior attachment of UP.
a. insertion into the lamina papyracea on the right side and skull base on the left side
b. insertion into the middle turbinate bilaterally

Table 1. Distribution of superior attachment of UP

Superior attachment of UP	Right side		Left side	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Lamina papyracea	54	75.0%	53	73.6%
Skull base	13	18.1%	11	15.3%
Middle turbinate	5	6.9%	8	11.1%
Total	72	100%	72	100%

Table 2. Association of right superior attachment of UP and chronic frontal sinusitis				
Superior attachment of UP	**Not developed No (%)**	**Normal No (%)**	**Frontal sinusitis No (%)**	**Total sides No (%)**
Lamina papyracea	1 (1.4%)	30 (41.6%)	23 (31.9%)	54 (75%)
Skull base	0 (0.0%)	1 (1.4%)	12 (16.7%)	13 (18.1%)
Middle turbinate	1 (1.4%)	0 (0.0%)	4 (5.6%)	5 (6.9%)
Total	2 (2.8%)	31 (43%)	39 (54.2%)	72 (100%)

Likewise, total chronic frontal sinusitis was seen in 38 (52.8%) on the left side,with 29 (40.3%) frontal sinusitis had attachment into the lamina papyracea. Attachment to the skull base resulted in 5 (13.2%) chronic frontal sinusitis. Sinusitis resulting from attachment into the middle turbinate accounted for 4 (10.5%) of the cases. Frontal sinuses were not developed in 2.8% bilaterally. As with the right-side significant association was seen between the attachment of the UP and left chronic frontal sinusitis (P=0.002). (Table 3)

Table 3. Association of left superior attachment of UP and chronic frontal sinusitis				
Superior attachment of UP	Not developed No (%)	Normal No (%)	Frontal sinusitis No (%)	Total sides No (%)
Lamina papyracea	0 (0.0%)	24 (33.3%)	29 (40.3%)	53 (73.6%)
Skull base	0 (0.0%)	6 (8.3%)	5 (6.9%)	11 (15.3%)
Middle turbinate	2 (2.8%)	2 (2.8%)	4 (5.6%)	8 (11.1%)
Total	2 (2.8%)	32 (44.4%)	38 (52.8%)	72 (100%)

We also looked at the total number of chronic frontal sinusitis in relation to the total number of sides studied. As documented in the previous tables the total number of chronic frontal sinusitis was 77 out of 144 sides, out of which 52 (67.5%) had the superior attachment of the uncinate process into the lamina papyracea. Seventeen (22.2%) had the attachment of the uncinate process into the skull base and 8 (10.3%) had attachment into the middle turbinate. This is documented in Table 4.

DISCUSSION

Chronic frontal rhinosinusitis is a common condition frequently encountered in the ENT outpatient, which can lead to considerable morbidity for the patient. Among the various factors leading to this condition, we looked at the association between the superior attachment of the uncinate process and chronic frontal sinusitis. Our demographics showed younger age groups were more affected, with 30.6% between 20 to 29

Table 4. Superior attachment of UP and chronic frontal sinusitis		
Superior attachment of UP	Frontal Sinusitis present No. (%)	Total sides No. (%)
Lamina papyracea	52 (67.5%)	107 (74.3 %)
Skull base	17 (22.2%)	24 (16.7 %)
Middle turbinate	8 (10.3 %)	13 (9.0 %)
Total	77 (100%)	144 (100 %)

years followed by 25% in both 30 to 39 and 40 to 49 age groups. This was similar to a study done by Singh I., who also showed that in his study two third of the cases were below 35 years with 40% of the cases between18 to 25 years.[7] Tuli et al. also demonstrated that 30% patients in their study were between the ages of 21-35 years with chronic sinusitis.[8] One plausible reason for this is that younger patients are more active and are involved in more outdoor activities. Likewise younger patients are also more concerned about their health and tend to seek medical care earlier compared to other age groups. Similarly, female patients with chronic rhinosinusitis were seen to be higher in numbers than males, which again is similar to the study done by Singh I. This could be because females in our country are more involved in household chores, agriculture and are generally more exposed to various allergens.

It is imperative to understand the anatomy of the frontal sinuses along with its drainage to comprehend the factors responsible for the development of sinusitis. In this respect we need to understand the osteomeatal complex, which is the small compartment located in the area between the middle turbinate and the lateral nasal wall in the middle meatus and this represents the region for drainage of anterior ethmoid, maxillary and frontal sinuses. Variations in any one of the components of the ostiomeatal complex (OMC) can lead to improper drainage of these sinuses causing chronic frontal sinusitis.[9]

The uncinate process is a key structure of the anterior OMC, which is important for drainage and ventilation. The OMC consists of the hiatus semilunaris, a two-dimensional crescent-shaped region located between the free edge of the UP and the anterior surface of the bulla ethmoidalis, extending laterally into the ethmoid infundibulum.[10,11] The superior attachment of the uncinate process will determine the direction of frontal sinus outflow that finally drains into the middle meatus and ethmoidal infundibulum, either medial or lateral to UP.[12] This drainage mechanism is considered as one of the important factors in the development of chronic frontal sinusitis.

In our study the maximum number of superior attachments of the UP was seen to be into the lamina papyracea on both sides. It was noted that the right side had 75.0% attachment into the lamina papyracea while on the left side it was 73.6%. This was comparable to studies done by Sagar et al, Tuli et al. and Turgut et al. that also showed a relatively higher percentage of attachment of the UP into the lamina papyracea, 82%, 79.8% and 76% respectively. [8,13,14]However, Srivastava et al and Min Y et al. found a slightly lower percentage of attachments into the lamina papyracea 57.8% and 54%. [9,15]In contrast, Krzeski et al. only had 17.8% attachment into the lamina papyracea.[12]

We noted that on the right-side the attachment of the UP to the skull base was seen in 18.1%, whereas on the left side it was 15.3%. Similarly, Srivastava et al and Tuli et al found 20.3%, 14% and Min Y et al. 24.5% into the skull base, nevertheless, Krzeski reported 33.12% attachment into the skull base, which was higher than the other studies. [12]Attachment of the UP to the middle turbinate was found in 14.33% by Krzeski, 21.5% by Min et al., 3% by Tuli and 6.2% by Srivastava. Middle turbinate attachment was seen in 6.9% on the right side and 11.1% on the left side in our study. Most of the studies showed that the most common type of superior attachment of the UP was into the lamina papyracea followed by the skull base and middle turbinate, which was similar in our study. Overall, we found frontal sinuses were not developed in 2.8% which is similar to the study done by Moideen SP et al., 2.5%.[16]

Considering the attachments of the UP and their relation it was seen that there was significant association on both sides with superior attachment of the uncinate process and chronic frontal sinusitis (p=0.001 and p=0.002 respectively). This was similar to studies done by Gnanavelraja C et al.[17] Taking into account both sides, 67.5% of superior attachment of the uncinate process into the lamina papyracea was seen to give rise to chronic frontal sinusitis that was similar to other studies.[8,9,13,14]

The pathophysiology explaining this phenomenon seems to be unclear, however, it has been speculated the superior attachment of uncinate process changes the pattern of drainage of frontal sinus, which may be one factor determining the development of frontal sinusitis.Theoretically, attachment into lamina papyracea is likely to have less frontal sinusitis because the frontal sinus drains directly into the middle meatus. However, in our study, frontal sinusitis was more frequent than in this type. Similar findings have been reported in literature as well.[8,9,13,14] This finding suggests that several other factors, such as airflow of the nasal cavity and the status of nasal mucosa other than simple anatomic narrowing of the OMC may play an important role in functional and anatomic disturbance of OMC. The cause of frontal sinusitis in patients with lamina papyracea attachments may be attributed to infundibular disease displacing the uncinate process medially and obstructing the frontal sinus drainage between the uncinate and middle turbinate.[15] Several other factors have also been previously discussed regarding the pathophysiologic process of chronic frontal sinusitis. Kuhn classified a number of cells that can lead to obstruction of the frontal recess and cause frontal sinusitis. These are namely frontal recess cells including agger nasi, supraorbital ethmoid cells, frontal cells, frontal bulla cells, suprabullar cells, and interfrontal sinus septal cells.[18] In addition to anatomical obstruction, mucosal obstruction of the frontal recess plays an important role in chronic frontal sinusitis.[19] There are also different factors such as hypoxia, dehydration, infection, foreign bodies, environmental irritants, trauma, tumor, and allergens that can affect the frontal sinus physiologic functions by disrupting the mucociliary clearance.[20] Further studies regarding the superior attachment of the UP in larger sample may identify attachment to lamina papyracea as an independent major contributing factor to chronic frontal sinusitis.

CONCLUSIONS

Chronic frontal rhinosinusitis was more common in the younger age group and among female patients. Among the superior attachments of the uncinate process, attachment into the lamina papyracea was the commonest. It was noted that frontal sinusitis was significantly associated with the superior attachment of the uncinate process.

REFERENCES

1. Dalgorf D M, Harvy R J. Anatomy of Nose and Paranasal Sinuses. In: Watkinson JC, Clarke RW, edit ors. Scott-Brown's Otorhinolaryngology Head and Neck Surgery. 8th ed. Vol. I, London: CRC Press; 2019:961-76.
2. Stammberger HR, Kennedy DW. Anatomic Terminology Group. Paranasal sinuses: anatomic terminology and nomenclature. Ann Otol Rhinol Laryngol Suppl. 1995 Oct;167(6):7-16. PMID: 7574267
3. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. European

Archives of Oto-rhino-laryngology. 1990 Mar;247(2):63-76. DOI: 10.1007/BF00183169

4. Benninger MS, Ferguson BJ, Hadley JA, Hamilos DL, Jacobs M, Kennedy DW, Lanza DC, Marple BF, Osguthorpe JD, Stankiewicz JA, Anon J. Adult chronic rhinosinusitis: definitions, diagnosis, epidemiology, and pathophysiology. Otolaryngology-Head and Neck Surgery. 2003 Sep 1;129(3):S1-32.DOI: 10.1016/s0194-5998(03)01397-4
5. Mancuso AA, Hanafee WN: Computed Tomography and Magnetic Resonance Imaging of the Head and Neck: Malignant Sinuses, Benign Sinuses, Facial Trauma. (2nd ed) Baltimore: Williams & Wilkins, 1985; 1–42.
6. Cashman EC, MacMahon PJ, Smyth D. Computed tomography scans of paranasal sinuses before functional endoscopic sinus surgery. World journal of radiology. 2011 Aug 8;3(8):199. DOI: 10.4329/wjr.v3.i8.199
7. Singh I, Sherstha A, Gautam D. Chronic rinosinusitis and nasal polyposis in Nepal. An International Journal Clinical Rhinology. 2010 Aug 1;3(2):87-91. DOI: 10.1016/j.jaip.2016.04.012
8. Tuli IP, Sengupta S, Munjal S, Kesari SP, Chakraborty S. Anatomical variations of uncinate process observed in chronic sinusitis. Indian Journal of Otolaryngology and Head & Neck Surgery. 2013 Apr;65(2):157-61. DOI: 10.1007/s12070-012-0612-8
9. Srivastava M, Tyagi S. Role of anatomic variations of uncinate process in frontal sinusitis. Indian Journal of Otolaryngology and Head & Neck Surgery. 2016 Dec;68(4):441-4. DOI: 10.1007/s12070-015-0932-6
10. Stammberger H, Hawke M. Essentials of endoscopic sinus surgery. St. Louis: Mosby Inc. 1 st Edition. 1993:01-108.
11. Güngör G, Okur N, Okur E. Uncinate process variations and their relationship with ostiomeatal Complex: a pictorial essay of multidedector computed tomography (MDCT) findings. Polish Journal of Radiology. 2016;81:173. DOI: 10.12659/PJR.895885
12. Krzeski A, Tomaszewska E, Jakubczyk I, Galewicz–Zielińska A. Anatomic variations of the lateral nasal wall in the computed tomography scans of patients with chronic rhinosinusitis. American journal of rhinology. 2001 Sep;15(6):371-5. DOI:10.1177/194589240101500603
13. Sagar GR, Jha BC, Meghanadh KR. A study of anatomy of frontal recess in patients suffering from 'chronic frontal sinus disease'. Indian Journal of Otolaryngology and Head & Neck Surgery. 2013 Aug;65(2):435-9. DOI: 10.1007/s12070-013-0653-7
14. Turgut S, Ercan I, Sayın I, Başak M. The relationship between frontal sinusitis and localization of the frontal sinus outflow tract: a computer-assisted anatomical and clinical study. Archives of Otolaryngology–Head & Neck Surgery. 2005 Jun 1;131(6):518-22. DOI: 10.1001/archotol.131.6.518
15. Min YG, Koh TY, Rhee CS, Han MH. Clinical implications of the uncinate process in paranasal sinusitis: radiologic evaluation. American Journal of

Rhinology. 1995 May;9(3):131-6. DOI:10.2500/105065895781873782

16. Moideen SP, Khizer Hussain Afroze M, Mohan M, Regina M, Sheriff RM, Moideen CP. Incidence of frontal sinus aplasia in Indian population. Int J Otorhinolaryngol Head Neck Surg 2017;3:108-11. DOI:10.18203/issn.2454-5929.ijohns20164811
17. Gnanavelraja C, Senthilnathan V, Vijayakumar M. Anatomical variations in the superior attachment of uncinated process and its association with frontal sinusitis. MIMJ. 2014;1(8):399-401. http://www.medpulse.in
18. Kuhn FA. Chronic frontal sinusitis: the endoscopic frontal recess approach. Operative techniques in otolaryngology-head and neck surgery. 1996 Sep 1;7(3):222-9. DOI:

https://doi.org/10.1016/S1043-1810(96)80037-6

19. Jacobs JB. 100 years of frontal sinus surgery. The Laryngoscope. 1997 Nov;107(S83):1-36. DOI: 10.1097/00005537-199711001-00001
20. McLaughlin RB, Rehl RM, Lanza DC. Clinically relevant frontal sinus anatomy and physiology. Otolaryngologic Clinics of North America. 2001 Feb 1;34(1):1-22. DOI: 10.1016/s0030-6665(05)70291-7

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