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Original Article

Comparative Evaluation of Pre-operative MDCT Findings and Intraoperative ESS Findings with Regard to Osteomeatal Complex in Patients With Chronic Rhinosinusitis

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Abstract

Background and Objective: Background and objective of the study were to determine how well the pre-operative multidetector-row computed tomography (MDCT) findings and intraoperative endoscopic sinus surgery findings correlate in patients with chronic rhinosinusitis (CRS) and to assess the various anatomical variations of the osteomeatal complex in these patients.

Materials and Methods: A total of 100 patients falling within the inclusion criteria with diagnosed CRS who had given consent for participating in this study were analyzed. The study period was from January 2016 to December 2016. In these patients, a detailed history and examination were done, counseled regarding the necessity of MDCT scan imaging of the nose and sinuses and further about the need for endoscopic evaluation and functional endoscopic sinus surgery (FESS). Scans were evaluated preoperatively as per Lund–Mackay CT scan score and anatomic variants regarding OMC were noted. Later, intraoperative findings were noted, and kappa statistics was used to analyze the agreement between MDCT and intraoperative endoscopic findings.

Results: Agger nasi, concha bullosa, medial and lateral deviation of the uncinate process and paradoxical middle turbinate showed a very good correlation of agreement between pre-operative CT scan and operative findings. Excellent correlation was found in case OMC obstruction, and there was a very good correlation of agreement between pre-operative CT scan and operative findings.

Conclusion: MDCT shows an increased sensitivity compared to routine CT in detecting OMC obstruction, and it had a very good correlation with intraoperative findings. There was an excellent correlation between MDCT and intraoperative findings in cases of all anatomic variants studied except concha bullosa. In conclusion, MDCT can help clinicians to better predict the OMC status pre-operatively and thereby guide FESS.

Key words: Chronic rhinosinusitis, Multidetector-row computed tomography, Osteomeatal complex

INTRODUCTION

Chronic rhinosinusitis (CRS) is one of the most common causes of a headache for which consultation of an otorhinolaryngologist is sought for. It affects a major proportion of the population worldwide and causes significant physical symptoms and emotional impairment adversely affecting the quality of life.

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The endoscopic sinus surgery is a minimally invasive technique which aims mainly at the removal of diseased mucosa and any pathology causing the obstruction of the osteomeatal complex, resulting in re-establishment of mucociliary drainage, and ventilation of paranasal sinuses.

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Computer tomography (CT) scan is the method of choice for evaluation of paranasal sinuses before surgery, and the coronal plane is the preferred imaging plane because it displays the osteomeatal complex the best. Safe, meticulous, and complete endoscopic surgery can be performed only after interpreting the CT scan, which gives detailed bony anatomy of the area. There is a high correlation between findings of CT examination and intraoperative endoscopic findings, but there are discrepancies also. In several studies, the findings that suggested sinus disease were intraoperatively seen polyps, purulent discharge, and edematous mucosa. Prospective studies of endoscopy demonstrate a sensitivity and specificity of 75% and 84%, respectively, when correlated with pre-operative routine CT for CRS. Technical developments in computer-assisted tomography such as multidetector-row CT (MDCT) help the surgeon in increasing diagnostic accuracy. Axial MDCT with secondary multiplanar reformation provides the necessary pre-operative information regarding the extent of disease and sinus anatomy. Routine head CT has an effective dose of 1–2 mSv to the whole body. The standard-dose MDCT protocol delivered a radiation dose of 0.70 mSv in men and 0.76 mSv in women. Hence, MDCT of paranasal sinus possesses the potential for a reduction in the radiation dose by 20%.

This study is undertaken to find out how well the pre-operative MDCT findings correlate with intraoperative endoscopic sinus surgery findings and to recognize the anatomical variations of osteomeatal complex region.

Objective of the Study

The objective of the study was to determine how well the pre-operative MDCT findings correlate with the intraoperative endoscopic sinus surgery findings with regard to osteomeatal complex, in patients undergoing functional endoscopic sinus surgery (FESS) for CRS unresponsive to medical management, and to assess the distribution of anatomic variants related to osteomeatal complex in this study population.

MATERIALS AND METHODS

A prospective study of 100 patients with clinical diagnosis of CRS, refractory to medical management and planning for FESS was done in the Department of ENT, Sree Gokulam Medical College, and Research Foundation from January 2016 to December 2016. Patients with the previous alteration of the paranasal sinus anatomy due to facial trauma, aggressive fungal infection, infiltrating tumors, and pregnant patients were excluded. In these patients, a detailed history and examination were done, counseled regarding the necessity of MDCT scan imaging of the nose and sinuses and further about the need for endoscopic evaluation and FESS. Informed consent was taken from all the cases, and data regarding the patients were collected. Scans were taken and evaluated preoperatively as per Lund–Mackay CT scan score. Later, intraoperative findings were noted, and the data were coded and entered to Microsoft Excel, analyzed using SPSS software by means of kappa statistics to determine the agreement between pre-operative MDCT and intraoperative endoscopic findings.

RESULTS AND ANALYSIS

In this study, data regarding sociodemographic variables such as age and sex were collected.

The mean age of the study population was 35.15 ± 13.48 years. The highest number of patients was in the range of 30–60 years. The percentage of males (53%) was found to be more than females (47%). 10% of patients had undergone previous sinus surgery, now needing revision surgery.

The most common presenting symptom in the study population nasal obstruction (100%) which was present in all patients in this study group. It was followed by nasal discharge/purulence/discolored postnasal discharge (91%), cough (79%), headache and facial pain (73%), dental pain (64%), and facial congestion/fullness (63%). Less common symptoms were fatigue (16%), hyposmia (14%), halitosis (11%), ear pain/pressure/fullness (10%), and purulence on nasal cavity examination (5%).

On doing MDCT peripheral nervous system (PNS), maxillary (93%) and anterior ethmoid sinuses (93%) were found to be the most commonly involved sinuses, followed by posterior ethmoid sinuses (79%) and frontal sinuses (66%). Sphenoid sinus (58%) was the least involved sinuses radiologically. OMC was obstructed in 44% of the study group.

Analyzing the MDCT, Lund and Mackay scores of CRS showed that a maximum number of 41 (41%) patients had score between 11 and 15 and minimum number of 1 patient had their scores between 21 and 24. The mean score was 9.52 ± 3.76.

Comparative Assessment of Anatomical Variants Regarding OMC on MDCT and FESS

In MDCT, the most common anatomical variant was agger nasi seen in 72% of the study population followed by concha bullosa (53%). The least common anatomical variant with regard to OMC was Haller's cell seen in only 9% of the study population. Intraoperatively, the most

common anatomical was agger nasi seen in 72% of the study population followed by concha bullosa (61%) and the least common anatomical variant with regard to OMC was Haller's cell seen in only 5% of the study population [Table 1 and Graph 1].

Excellent correlation was found in cases of agger nasi, medial and lateral deviation of the uncinate process, paradoxical middle turbinate and Haller's cell. Correlation was good for concha bullosa. Agger nasi, concha bullosa, medial and lateral deviation of uncinate process, and paradoxical middle turbinate showed a very good correlation of agreement between pre-operative CT scan and operative findings, while Haller's cell showed a good correlation of agreement [Table 2]. In our study, all parameters except Haller's cell were statistically significant [Table 2].

Table 1: Comparative assessment of anatomical variants with regard to OMC MDCT versus ESS

Anatomical variants	MDCT	ESS
	n (%)	*n* (%)
Agger nasi	72 (72.0)	72 (72.0)
Concha bullosa	53 (53.0)	61 (61.0)
Medial deviation of uncinate process	26 (26.0)	26 (26.0)
Lateral deviation of uncinate process	13 (13.0)	13 (13.0)
Paradoxical middle turbinate	13 (13.0)	13 (13.0)
Haller's cell	9 (9.0)	5 (5.0)

MDCT: Multidetector-row Computed tomography, ESS: Endoscopic sinus surgery

Comparative Assessment of Other Sinus Related Findings

The other sinus related finding we studied was OMC obstruction which shoes a prevalence of 44% in MDCT and a prevalence of 43% intraoperatively [Table 3 and Graph 2].

Excellent correlation was found in case OMC obstruction, and there was a very good correlation of agreement between pre-operative CT scan and operative findings [Table 4]. $P < 0.05$ was statistically significant [Table 4].

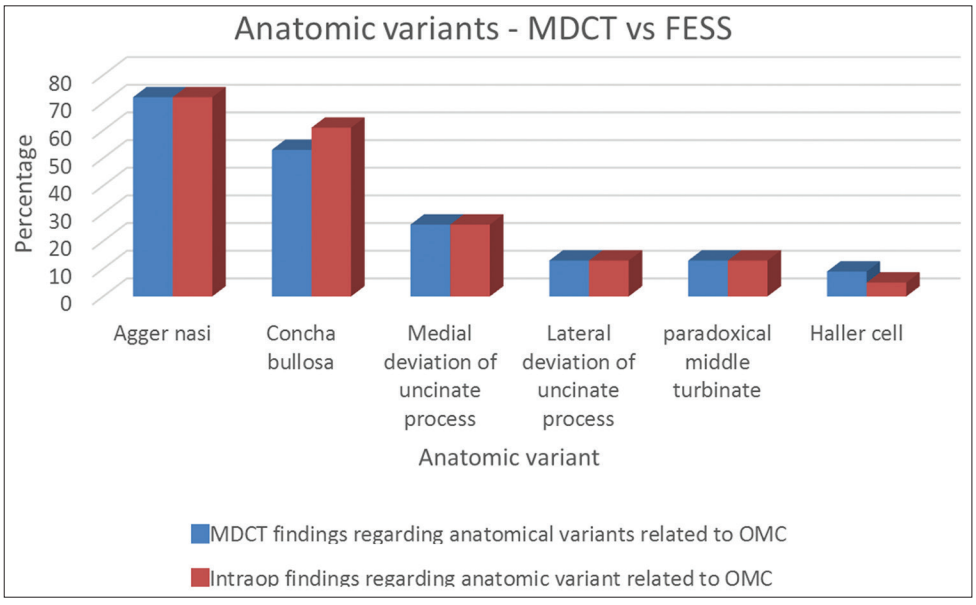
DISCUSSION

Pathogenesis of sinusitis was a point of interest from 17th century onward. In the early 19th century, Zuckerkandl

Table 2: Correlation between preoperative MDCT scan and endoscopic sinus surgery findings in chronic sinusitis with regard to anatomical variants

Anatomical variant	Sensitivity	Specificity	PPV	NPV	Correlation	κ	Agreement	*P* value	Statistical significance
Agger nasi	100	100	100	100	Excellent	1	Very good	<0.01	Significant
Concha bullosa	86.9	100	100	82.97	Good	0.838	Very good	<0.01	Significant
Medial deviation of uncinate process	100	100	100	100	Excellent	1	Very good	<0.01	Significant
Lateral deviation of uncinate process	100	100	100	100	Excellent	1	Very good	<0.01	Significant
Paradoxical middle turbinate	100	100	100	100	Excellent	1	Very good	<0.01	Significant
Haller's cell	100	95.8	55.6	100	Excellent	0.695	Good	0.142	Insignificant

PPV: Positive predictive values, NPV: Negative predictive values, MDCT: Multidetector-row Computed tomography. *Sensitivity of - > 90 is excellent correlation, > 80 is good correlation, > 70 is acceptable, > 60 is poor correlation. †Kappa's value: 0.81–1.0 is very good agreement between CT scan and operative findings, 0.61–0.80 is good agreement, 0.41–0.60 is moderate agreement, 0.21–0.40 is fair agreement, <0.2 is poor agreement



Graph 1: Percentage distribution of anatomical variants with regard to OMC detected by multidetector-row computed tomography versus endoscopic sinus surgery

described pathologies affecting paranasal sinuses.[1] Open approaches to the maxillary sinus were first described as early as the 18th century. The Caldwell-Luc procedure was described in 1893 by George Caldwell and further elucidated in France by Henri Luc in 1897.[2] The first attempt at nasal endoscopy was made by Hirshman in 1901, using a modified cystoscope.[3] Endoscopic sinus surgery was introduced in Europe by Messerklinger in 1967. In 1985, Kennedy introduced the technique of FESS into the United States.[4] It was not until the middle of 20th century that Professor H. Hopkins developed rod optic telescope, following which endoscopes incorporating fiber optic light delivery and rod optical system which opened up the possibility of routine endoscopic examination of the nose and paranasal sinuses.[5] Stammberger explained the role of diagnostic nasal endoscopy and computed tomography (CT) in sinus surgery leading to the concept of image-guided surgery in recent years.[6]

CRS is a group of disorders characterized by inflammation of the mucosa of nose and paranasal sinuses for at least 12 weeks duration. In 1996, the American Academy of Otolaryngology–Head and Neck surgery multidisciplinary rhinosinusitis task force (RTF) defined adult rhinosinusitis diagnostic criteria. In 2003, the RTF definition was amended to require confirmatory radiographic or nasal endoscopic or physical examination findings in addition to suggestive history.[6] RTF has given a list of symptoms for diagnosing CRS. There are at least two major factors or one major factor with two or more minor factors: Major factors are (1) facial pain, (2) facial congestion, (3) nasal obstruction, (4) nasal discharge, (5) hyposmia/anosmia, (6) purulence in nasal cavity, and (7) fever. Minor factors are (1) headache, (2) fever, (3) halitosis, (4) fatigue, (5) dental pain, (6) cough, and (7) ear pain/pressure.

The anatomy of drainage revolves around the osteomeatal unit, which is not a single morphologic structure but a combination of the following structures: Uncinate process, ethmoid bulla, middle turbinate, infundibulum,

Table 3: Assessment of OMC obstruction MDCT versus ESS

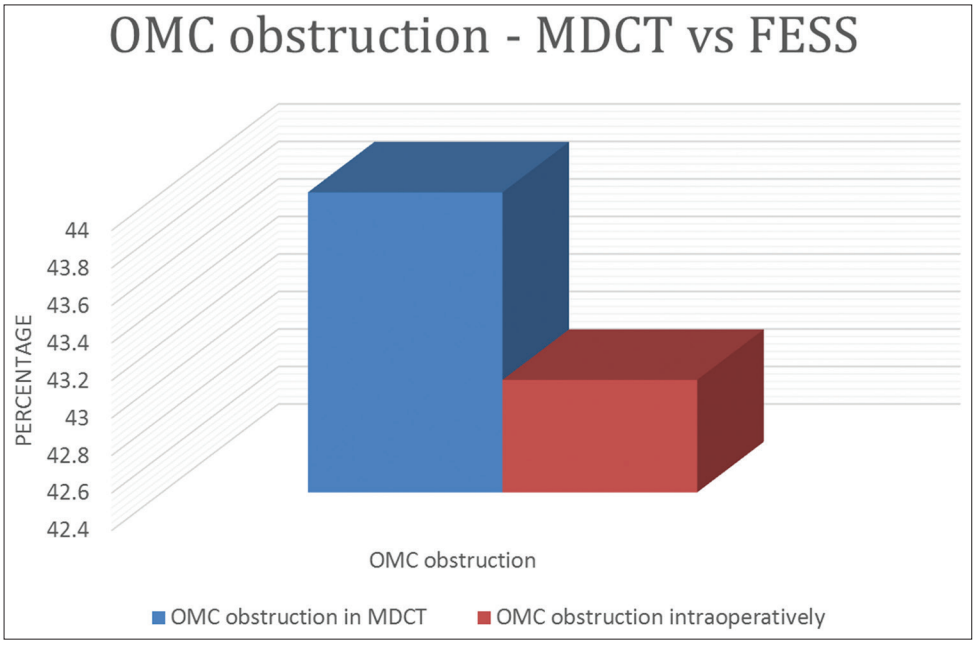
Status of OMC	MDCT	ESS
	n (%)	*n* (%)
OMC obstruction	44 (44.0)	43 (43.0)

MDCT: Multidetector-row Computed tomography, ESS: Endoscopic sinus surgery

Table 4: Correlation between preoperative MDCT scan and endoscopic sinus surgery findings in chronic sinusitis with regard to OMC obstruction

Status of OMC	Sensitivity	Specificity	PPV	NPV	Corelation	κ	Agreement	*P* value	Statistical significance
OMC obstruction	93.2	94.6	93.2	94.64	Excellent	0.878	Very good	< 0.01	Significant

*Sensitivity of - >90 is excellent correlation, >80 is good correlation, >70 is acceptable, >60 is poor correlation. †Kappa's value: 0.81–1.0 is very good agreement between CT scan and operative findings, 0.61–0.80 is good agreement, 0.41–0.60 is moderate agreement, 0.21–0.40 is fair agreement, <0.2 is poor agreement, CT: Computer tomography, MDCT: Multidetector-row Computed tomography, PPV: Positive predictive values, NPV: Negative predictive values



Graph 2: Percentage distribution of OMC obstruction detected by multidetector-row Computed tomography versus functional endoscopic sinus surgery

and hiatus semilunaris. According to Mackay and Lund, the osteomeatal complex acts as a drainage pathway for maxillary, anterior ethmoids, and frontal sinus. In several areas of OMC, two mucosal layers contact each other, thus increasing the likelihood of local impairment of mucociliary clearance.

The role of imaging is to document the disease extent, to answer questions regarding ambiguous vases, and to provide an accurate display of the anatomy of the sinonasal system. Now, CT has been the modality of choice for imaging evaluation of the morphology in this area. The introduction of MDCT has widened the range of applications of helical CT in clinical imaging, especially in the field of virtual imaging. With the help of MDCT, it is possible to obtain thin sections with improved Z-axis resolution, high-quality multiplanar resolutions, and volume rendered images. Volume acquisition makes it possible to retrospectively reconstruct overlapping images, thus producing high quality three-dimensional reconstruction. MDCT possesses the potential of radiation dose reduction by 20%; therefore, it should be the imaging method of choice in chronic sinusitis.[7]

CT has always been the gold standard for pre-operative evaluation. There is a high correlation between findings of CT examination and intraoperative endoscopic findings, but there are discrepancies also. In several studies, the findings that suggested sinus disease were intraoperatively seen polyps, purulent discharge, and edematous mucosa.[8] Till date, very few studies are there on the correlation between endoscopy and CT scan in the diagnosis of CRS on patients, but the detailed correlation of per-operative endoscopic findings and pre-operative CT scan findings is not much reported.

Our study was a prospective observational study aimed at a comparative evaluation of pre-operative MDCT findings and intraoperative endoscopic sinus surgery findings with regard to osteomeatal complex in patients with CRS.

The demographic data analysis of this study showed that 40% of the patients who underwent FESS for refractory CRS belongs to the age group 30–60 years. The mean age was 35.15 ± 13.48 years ranging from 18 to 81 years. The percentage of females (53%) was more than males (47%).

Majority of the study population presented with nasal obstruction (100%) which was present in all patients in this study group. It was followed by nasal discharge/purulence/discolored postnasal discharge (91%), cough (79%), headache and facial pain (73%), dental pain (64%), and facial congestion/fullness (63%). Less common symptoms were fatigue (16%), hyposmia (14%), halitosis (11%), ear pain/pressure/fullness (10%), and purulence on nasal cavity examination (5%). Maxillary sinus was found to be the most common sinus involved in MDCT in patients with CRS in our study.

In the present study, the most common anatomical variant in MDCT was agger nasi (72%), which are present in the area anterior and superior to the insertion of middle turbinate and its relationship on CT is essential for the diagnosis of chronic frontal sinusitis.

Its prevalence varies widely in studies by different authors such as Midilli *et al.*, Gupta *et al.*, and Kaygusuz *et al.* at 80.4%, 68.8%, and 64.6%, respectively.[9-11] Our study had similar results to Narendrakumar and Khojastepour *et al.* where the most common anatomical variant was agger nasi.[12,13] The sensitivity of MDCT was 100% for detecting agger nasi, and there was very good correlation between MDCT and FESS in our study ($\kappa = 1$, $P < 0.01$) which was similar to the previously conducted study by Devan *et al.* and Ravi *et al.*[14,15] with radiological imaging by CT.

The second most common anatomical variant detected in our study by MDCT was concha bullosa (95.3%) which is a pneumatized middle turbinate, which when large can cause blockage of middle meatus leading to sinusitis. This was similar to the study conducted by Bolger *et al.* where the incidence of CB in CRS was 53%.[16] The sensitivity of MDCT for detecting CB was 86.9% and there was a good correlation between MDCT and FESS in our study ($\kappa = 0.838$, $P < 0.01$), similar to previous studies by Prashant and Harugop and Ravi *et al.*[15,17] with radiological imaging by CT. Intraoperatively, the incidence of CB in our study was 61%. The decreased detection of CB by MDCT may be attributed to the presence of inflammatory exudates within the pneumatized CB.

Uncinate process variations were the third most common findings in our study with medial deviation of the uncinate process seen in 26% and lateral deviation of the uncinate process in 13%. Uncinate process is a key anatomical structure in the lateral wall of the nasal cavity; the medial deviation of which can make contact with middle meatus threatening its permeability and lateral deviation can cause narrowing of hiatus semilunaris and infundibulum. In a similar previous study conducted by Mamatha *et al.*, the incidence of medially rotated uncinate process was 25% which is close to our study.[18] Laterally rotated uncinate showed varying incidence in previous studies. Fadda *et al.* and Krzeski *et al.* showed a presence of laterally rotated uncinate in 21.4% and 9.5%, respectively.[19,20] The sensitivity of MDCT in detecting uncinate process variations was 100%, and there was an excellent correlation between MDCT and FESS in our study ($\kappa=1$, $P < 0.01$)

which was similar to the previously conducted study by Devan *et al.*[14] with radiological imaging by CT.

Paradoxical middle turbinate is a reversal of normal outward concavity of middle turbinate and can cause attenuation of normal airflow dynamics. The prevalence of paradoxical middle turbinate by MDCT in this study was 13%. Previous studies by Pérez-piñas *et al.* and Khojastepour *et al.* showed a prevalence of 10% detected by CT[21,22] and Vineetha *et al.* showed a prevalence of 11% detected by CT.[23] The sensitivity of MDCT in detecting paradoxical middle turbinate was 100%, and there was very good correlation between MDCT and FESS in our study (κ=1, $P < 0.01$) which was similar to the previously conducted study by Prashant and Harugop with radiological imaging by CT.[17]

Haller's cell, also called infraorbital ethmoidal cells, can cause narrowing of maxillary ostium or infundibulum predisposing to recurrent maxillary sinusitis. In our study, the prevalence of Haller's cell was 9%. This was in comparison with the previously conducted study by Zinreich *et al.* where the prevalence was 10%.[24] The sensitivity of MDCT in detecting Haller's cell was 100%, and there was good correlation (κ = 0.695, $P < 0.01$) between MDCT and FESS in our study. Previous studies by Devan *et al.* showed poor correlation between CT and FESS and very good correlation between CT and FESS were found in studies conducted by Ravi *et al.*[14,15]

On analyzing the status of OMC, 44% of the study population showed obstructed OMC detected by MDCT, but only 43% showed actual obstruction intraoperatively. This variation in findings may be due to the presence of edematous mucosa or discharge that may be cleared off later. Our study also showed that MDCT had a sensitivity of 93.2% in detecting OMC obstruction and there was a very good correlation (κ = 0.878, $P < 0.01$) between pre-operative MDCT and intraoperative findings with regard to OMC obstruction. Previously conducted studies with routine CT showed poor to moderate correlation for the same findings. In studies conducted by Handanakere *et al.* and Prashant and Harugop, there was moderate correlation and in a study conducted by Kaku *et al.*, there was poor correlation between CT and intraoperative findings.[17,25,26] This results may be due to the superiority of MDCT compared to routine CT in the detection of this pathology.

The findings which we observed in our study points to the fact that pre-operative MDCT has a good correlation between the anatomical variants with regard to OMC which plays a pivotal role in CRS pathogenesis, and it has a very good correlation with regard to OMC obstruction which is a key factor related to the severity of CRS compared to intraoperative findings compared to previously conducted studies with routine CT. Going by the results of this study, it can be said that MDCT can be a better predictor of OMC related findings in patients with CRS and the necessity of unwanted surgery can be limited to a certain extent.

CONCLUSION

This was a prospective correlational descriptive clinical study conducted in 100 patients with diagnosed CRS refractory to medical treatment who had been advised FESS. Most patients were in third to sixth decades of their life, with a slightly more incidence in males (53%) compared to females (47%). The most common symptom with which they presented was nasal obstruction followed by nasal discharge/discolored postnasal discharge and cough. On evaluating the patients with MDCT PNS, the most common sinus involved was maxillary and anterior ethmoid sinus (93%) and least involved was sphenoid sinus (58%). The results of intraoperative findings regarding anatomic variants and OMC obstruction are more conclusive in the elucidation of final diagnosis than that obtained by MDCT PNS. However, MDCT was useful to visualize anatomic variants and the status of OMC preoperatively. MDCT shows increased sensitivity compared to routine CT in detecting OMC obstruction, and it had a very good correlation with intraoperative findings. There was an excellent correlation between MDCT and intraoperative findings in cases of all anatomic variants except concha bullosa. Concha bullosa showed a good correlation. In conclusion, MDCT can help clinicians to predict the OMC status pre-operatively and thereby guide FESS.

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REFERENCES

1. Chang CC, Incaudo GA, Gershwin ME. Diseases of the Sinuses: A Comprehensive Textbook of Diagnosis and Treatment. New York:

Springer; 2014.
2. Cashman EC, Macmahon PJ, Smyth D. Computed tomography scans of paranasal sinuses before functional endoscopic sinus surgery. World J Radiol 2011;3:199-204.
3. Draf W. Endoscopy of the Paranasal Sinuses: Technique, Typical Findings, Therapeutic Possibilities. New York: Springer Verlag Inc.; 1983.
4. Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery. Theory and diagnostic evaluation. Arch Otolaryngol 1985;111:576-82.
5. Bull T, Mackay I. Scott-Brown's Otolaryngology. 6th ed., Vol. 4. Oxford, Boston: CRC Press; 1997.
6. Benninger MS, Ferguson BJ, Hadley JA, Hamilos DL, Jacobs M, Kennedy DW, *et al.* Adult chronic rhinosinusitis: Definitions, diagnosis, epidemiology, and pathophysiology. Otolaryngol Head Neck Surg 2003;129:S1-32.
7. Zojaji R, Mirzadeh M, Naghibi S. Comparative evaluation of preoperative CT scan and intraoperative endoscopic sinus surgery findings in patients with chronic rhinosinusitis. Iran J Radiol 2008;5:77-82.
8. Stankiewicz JA, Chow JM. Nasal endoscopy and the definition and diagnosis of chronic rhinosinusitis. Otolaryngol Head Neck Surg 2002;126:623-7.
9. Midilli R, Aladağ G, Erginöz E, Karci B, Savaş R. Anatomic variations of the paranasal sinuses detected by computed tomography and the relationship between variations and sex. Kulak Burun Bogaz Ihtis Derg 2005;14:49-56.
10. Kaygusuz A, Haksever M, Akduman D, Aslan S, Sayar Z. Sinonasal anatomical variations: Their relationship with chronic rhinosinusitis and effect on the severity of disease-a computerized tomography assisted anatomical and clinical study. Indian J Otolaryngol Head Neck Surg 2014;66:260-6.
11. Gupta AK, Gupta B, Gupta N, Tripathi N. Computerized tomography of paranasal sinuses: A roadmap to endoscopic surgery. Clin Rhinol Int J 2012;5:1-10.
12. Narendrakumar V. Anatomical variations in osteomeatal complex among patients undergoing functional endoscopic sinus surgery. Int J Clin Rhinol 2016;9:28-32.
13. Tandon S, Rathore P, Raj A, Prakash A, Wadhwa V. Correlation of computed tomographic findings and intraoperative findings in patients with chronic sinusitis. Int J Clin Rhinol 2017;10:78-85.
14. Devan P, Sheetal D, Manjunath P, Martin P, Satish K, Sancheti P. CT PNS do we really require before FESS? J Clin Diagn Res 2011;5:179-81.
15. Ravi P, Durga B, Lanke, Sasanka K. A correlation study of paranasal sinuses between operative endoscopic findings in fess and preoperative CT scan. J Evol Med Dent Sci 2016;5:36-40.
16. Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. Laryngoscope 1991;101:56-64.
17. Prashant R, Harugop AS. Correlation between pre-operative CT scan findings and operative findings during endoscopic sinus surgery in chronic sinusitis patients. Int J Adv Res Technol 2015;4:149-62.
18. Mamatha H, Shamasundar NM, Bharathi MB, Prasanna LC. Variations of ostiomeatal complex and its applied anatomy: A CT scan study. Indian J Sci Technol 2010;3:904-7.
19. 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. Am J Rhinol 2001;15:371-5.
20. Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G, *et al.* Multiparametric statistical correlations between paranasal sinus anatomic variations and chronic rhinosinusitis. Acta Otorhinolaryngol Ital 2012;32:244-51.
21. Khojastepour L, Mirhadi S, Mesbahi SA. Anatomical variations of ostiomeatal complex in CBCT of patients seeking rhinoplasty. J Dent (Shiraz) 2015;16:42-8.
22. Pérez-Piñas, Sabaté J, Carmona A, Catalina-Herrera CJ, Jiménez-Castellanos J. Anatomical variations in the human paranasal sinus region studied by CT. J Anat 2000;197 (Pt 2):221-7.
23. Vineetha JM, Rahul S, George J. Anatomical variations in the middle turbinate in patients with chronic rhinosinusitis: A radiological study. Int J Recent Sci Res 2016;7:12914-6.
24. Zinreich SJ, Kennedy DW, Rosenbaum AE, Gayler BW, Kumar AJ, Stammberger H, *et al.* Paranasal sinuses: CT imaging requirements for endoscopic surgery. Radiology 1987;163:769-75.
25. Kaku DR, Harugop AS. Correlation of computed tomography and nasal endoscopic findings in chronic rhinosinusitis. Indian J Health Sci Biomed Res 2017;10:116-23.
26. Handanakere SS, Devasanudra CR. Clinical study of correlation between preoperative CT scan findings with intraoperative findings in cases of chronic rhinosinusitis. Indian J Anat Surg Head Neck Brain 2016;2:49-52.

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