ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 6, Issue – 1, February - 2023, Page No. : 86 - 96

Anatomic variations of the osteomeatal complex and its relationship to patency of the maxillary ostium: a retrospective evaluation of cone-beam computed tomography and its implications for sinus augmentation

[1]Dr. Arun Kumar, MDS (PG 3rd Year), Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

[2]Dr. Sukant Sahoo, MDS, Professor and Head, Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

[3]Dr. Aakarshan Dayal Gupta, MDS, Reader, Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

[4]Dr. Yukti Sharma, MDS, Senior Lecturer, Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

[5]Dr. Farhan Ul Haq, MDS, Senior Lecturer, Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

[6]Dr. Shaik Arafath, MDS (PG 3rd Year), Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

Corresponding Author: Dr. Arun Kumar, MDS (PG 3rd Year), Department of Prosthodontics and Crown & Bridge, Shree Bankey Bihari Dental College & Research Centre, Masuri, Ghaziabad, U.P.

Citation of this Article: Dr. Arun Kumar, Dr. Sukant Sahoo, Dr. Aakarshan Dayal Gupta, Dr. Yukti Sharma, Dr. Farhan Ul Haq, Dr. Shaik Arafath, "Anatomic variations of the osteomeatal complex and its relationship to patency of the maxillary ostium: a retrospective evaluation of cone-beam computed tomography and its implications for sinus augmentation", IJDSIR- February - 2023, Volume – 6, Issue - 1, P. No. 86 – 96.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

AIM: The aim of the study was to evaluate an atomic variation of the osteomeatal complex and its relationship to patency of the maxillary ostium: A retrospective evaluation of Cone Beam Computed Tomo graphy and its implication for sinus augmentation. Objective: The objective of this study is to deter mine linear measurement soft hem axillary sinus height in sagittal section cranio- caudal extension, width Antero posterio r (A-P) dimensions in axial section and Antero posterior dimensi on in axial view. To determine incidence in variation in patency of osteo meatalcomplex, Uncinate process, In fundibulum and Hiatus semilunaris in axial section.

Material and method: This Retro spective studyincluded 200 patients, (100 males and 100

females), aged 20-65 years (mean age 43. 36 ± 12. 5 years). Five groups were created on the basis of age distribution: Group I: 20-30 years, Group II: 31-40 years, Group III: 41-50, Group IV: 51-60 years, GroupV: 61-65 years. The CBCT scans recorded and descriptive analysis was performed to understand thefrequency distribution of the anatomic variants indifferent groups and in each gender. The association between each variable and the patency of the osteomeatal complex was then analyzed using Pearson's chi squared test.

Results: Overall average height of maxillary sinus 29.51 +/- 5.17, Width 25.27 +/- 4.97, antero-posterior dimension 32.73 +/- 4.97, distance of ostium to sinus floor 27.77 +/- 5.09, Ostium diameter 3.26 +/- 1.26 and diameter of in fandibulam was 1.64 +/- 0.5. The difference in width of maxillary sinus was the only statistically significant parameter between males and females. Positive ostium patency was 82.5%, Presence of septa was seen in 43.5%, Pathology in 42.5%, Haller's cell in 33.5%, Unicate process in 33.5%, Variation in patency of osteomeatal complex, Ethmoid bulla in 81%, deviated nasal septum in 31% and concha bullosa in 30.5%

Conclusion: The clinical importance of patency of ostium and osteo meatal complex along with the various dimensions of maxillary sinus and associated anatomical variation which help clinician in planning and predicting the overall on gtermprognos is of sinusaug mentation procedures.

Keywords: Cone beam computed tomography; Ostium; maxillary sinus; osteomeatal complex; uncinate process; hiatus semilunaris.

Introduction

The reare four pairs of paranasal sinuses: the maxillary, ethmoid, frontal and sphenoid. They are air - filled, mucosa - lined spaces with in the maxillo facial region and skull centred on and communicating with then asalcavity.[1] The nose and paranasal sinuses form a functional unit as well as being an integral part of the respiratory tract with the trachea bronchial tree and lungs.[2] The maxillary sinuses were first illustrated and described by Leonardo da Vinci in1489 and later documented by the English anatomist Nathaniel Highmorein1651.The maxillary sinus, or Antrum of Highmore, lies within the body of the maxillary bone and is the largest and first to develop of the paranasal sinuses. The alveolar process of the maxilla supports the dentition and forms the inferior boundary of thesinus.[3] Furthermore, the anterior paranasal sinuses (i.e., the maxillary, anterior ethmoid and frontal sinuses) all drain into the osteomeatal unit. The anterior ethmoid, not the maxillary, sinus is considered the key anterior sinus in affecting the common drainage pathway of the anterior sinus group according to the basic principles of mucociliary clearance and endo scopicsinus surgery.[4] The maxillary sinus is located between the nasal and oral cavities. For this reason, itis the most sensitive region to the invasion of pathogens from the nasal ostium or oral cavity. Sinusitis of odontogenic causes originates from impairment in the Schneiderian membrane as a result of infection, usually of the maxillary tooth.[5] A normal sinus is not observed on a radio graph unless there is an increase in mucosal thickness or irritation by an allergic or infectious agent. Mild maxillary sinus muco salt Hicken in Gisa normal finding in asym Pto matic individuals. Infact, maxillary sinusitis has beenclassified as mucosal thickening exceeding 2 millimetre in most circumstances. Based on this, it has been suggested that maxillary sinus mucosal thickening over 2 millimetres should be considered as indicative of a patho logical condition.[6] The concept developed by Stamm berger and

Kennedy was a dopteddef in ing osteomeatal complex as a functional unit of the anterior ethmoid complexe presenting the final common pathway for drainage and ventilation of the frontal, maxillary and anterior ethmoids in uses (Freitas & Boasquevisque,2008).[7] The blockade in the osteomeatal complex (OMC) leads to impaired rain age of maxillary, frontal and anterior ethmoid sinuses thus causing chronic sinusitis. Thus, this emphasized the concept that osteomeatal complex is the key factor in the causation of chronic sinusitis. the paranasal sinuses will provide an anatomic roadmap of the paranasal sinuses to identify the presence of significant Ana to mi cab normalities, the location and severity of the disease and exact location of the obstruction.[8] Liu et al. demonstrated that greater the size of anatomical variant, the higher the frequency of association with paranasal sinus mucosal alterations at CT. Different types of anatomical variants present distinct relations with either clinical or Tomo graphic sinus disease. Main anatomical variants of osteo meatal complex are middle concha bullosa, paradoxical middle concha, Haller and agger nasi air cells, deviated nasal septum and enlarged ethmoidbulla.[9] The ostium is the exclusive path way for maxillary secretions to escape in to the middle meatus. Ostium patency, impaired epithelial function, or altered nasal secretions are some of the related patho physio logic features of underlying maxillary sinus disease.[10] The placement of end osseous implants may be difficult in an edentulous posterior maxilla with a severely atrophic posterior or increased sinus pneumatization. Bone grafting to the maxillary sinus floor superiorly can increase the bone height of the posterior maxilla and enable the placementofsuchimplants.[11] In particular, maxillary implants are inserted in the upward direction, opposing gravity, and achieving's table support is difficult if the alveolar bone facing the maxillary sinus is thin. To address this problem, a sinus - lifting procedure (which may be conducted with or without bone grafting) that includes elevation of the Schneiderian membrane of the maxillary sinus is typically required prior to dental implant placement. CBCT is valuable in evaluating the location and patency of the ostium for planning sinusaug mentationprocedures for dental implant place ment.12 The loss of the posterior maxillary teeth often results to insufficient bone volume owing to the resorption of the alveolar bone and the pneumatization of the maxillary sinus. Such conditions frequently do not allow to perform an oral rehabilitation of the region by means of implants. In order to increase the bone volume to make the installation possible, sinus floor elevation procedureshave been proposed.13 Despite availability research data backed by clinician evidence regarding importance of patency and locationof maxillary sinus ostium along with presence or absence of anatomical variations in the osteomeatal complex for sinus augmentation procedures, there is still a disparity/confusion among clinicians regarding the same. Therefore, this study assess the relationship of anatomic variation of the osteomeatal complex to the patency of the maxillary sinus ostium via Cone-Beam Computed Tomo graphy and its implication on sinus augmentation procedures and implant surgery.

Aim

The aim of the study was to evaluate Ana Tomi variations of the osteo meatal complex and its relationship to patency of the maxillary ostium: A retrospective evaluation of Cone Beam Computed Tomo graphy and its implication for sinus augmentation.

Objectives

The objective of this study is to determine linear measurements of the maxillary sinus height in sagittal

section cranio-caudal extension, width antero-posterior (A-P) dimension sin axial section and Antero posterior dimension in axial view. To deter mine incidence in variation in patency of osteo meatal complex, Uncinate process, In fundibulum and Hiatus semilunaris in axial section. Material and method This Retro spective study included 200 patients, aged18- 65years. The CBCT scans recorded from the outpatient Department of Prostho dontics and Crown & Bridge. The CONE Beam Computed Tomo graphy images were obtained using VATECSMART PLUS VERSION 1.27 (MODEL PHT-35LHS). Operating parameters were as follows: 5. 8 mA, 90 Kv, field of view: 10 X 8.5 voxel size: 0.12. The software provided with I mages in the axial, coronal, and sagittal aspect through multi - planarre construction of 0. 2 mm slices. The radiation exposure to each patient was 61µSv. The radio logical assessment of the anatomical variants was done by analyzing the coronal sections of the scans. The anato mical variants were observed for nasal septum, un cinate process, middle turbinates variants andmaxillary sinus ab normalities. Ostium patency was evaluated in the coronal section of each sinus and classified “Patent” or “Obstructed”. The most common variants observed were then correlated. Descriptive analysis was performed to understand the frequency distribution of the anatomic variants. The association between each variable and the patency of the Osteo meatal Complex was then analyzed using Pearson’s chi squared test.

Figure 1: VATEC Smart Plus version 1.27(modelpht-35 lhs)

Inclusion Criteria

- Subjects aged between 18 – 65 years.
- Patients who are advised CBCT for the following - Assessment of implant planning in maxillary posterior region.
- Patients with good generalized health status.

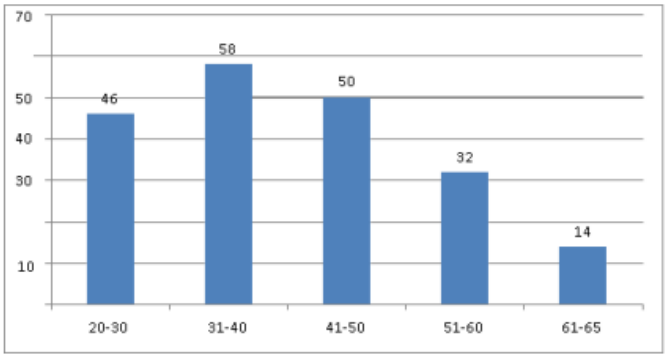
Exclusion Criteria

- Patients below 18 years of age and above 65 years of age.
- Patients who are suspected of having CA of maxillary region.
- Patients suspected of having cysts in the maxillary region.
- Metallic Arti facts that impair sinus visualization.
- Patients with fungal in fection of maxilla.
- Patients with debilitating systemic condition.

Results

A sample size of 200 patients was equal gender ratio (100 Female sand 100 (Males) and evaluated between the age groups of 20- 65 years. Samples were divided into 5 groups and the number of subjects in each group have been depicted in Graph 1. The average ages

distribution in Groups 1,2,3,4 and 5 were found to be 25. 04, 36.17, 45.66, 56.31 and 62.92 respectively.



Graph 1: Graphical representation of the distribution of subject based on age

	Height of Maxillary sinus	Width of Maxillary section	Antero-Posterior dimension	Distance of Ostium to Sinus Floor	Ostium Diameter	Diameter of Infundibulam
Average	29.51	25.27	32.73	27.77	3.26	1.64
St. Dev	5.17	4.97	4.97	5.09	1.26	0.5
N	200	200	200	200	200	200

Table 1: Distribution of average values by Parameterse valuated (Overall)

It was observed that over all the highest value was the Antero – posterior dimension of the Sinus and the lowest value was the diameter of the in fundibulum. Mean value of height of maxillary sinus for males was 26.33 and for females it was 24.29. This parameter for Group I was 27.66, Group II was 29.01, Group III was 30.09, Group IV

was 31.83 and Group V was 29.51. The result was not significant in gender or age group distribution. Mean value of width of maxillary sinus for males was 30.12 and for females it was 28.95. This parameter for Group I was 23.06, Group II was 25.60, Group III was 25.32, Group IV was 27.81 and Group V was 25.27. The result was statistically significant for both gender and age group distribution. Mean value of antero-posterior dimension for males was 33.29 and for females it was 32.22. This parameter for Group I was 31.14, Group II was 31.99, Group III was 32.89, Group IV was 35.43 and Group V was 32.73. The result was not significant in gender but was significant between age group distribution. Mean value of distance of ostium from sinus floor for males was 27.91 and for females it was 27.64. This parameter for Group I was 25.87, Group II was 28.80, Group III was 29.70, Group IV was 29.49 and Group V was 27.76. The result was not significant in gender but was significant between age group distribution. Mean value of ostium diameter for males was 3.27 and for females it was 3.24. This parameter for Group I was 2.61, Group II was 3.15, Group III was 3.61, Group IV was 3.45 and Group V was 4.08. The result was not significant in gender but was significant between age group distribution. Mean value of diameter of Infundibulam for males was 1.65 and for females it was 1.63. This parameter for Group I was 1.48, Group II was 1.71, Group III was 1.69, Group IV was 1.58 and Group V was 1.84. The result was not significant in gender or age group distribution.

Overall Prevalence of Maxillay Sinus	
Positive Ostium Patency	82.50%
Presence of septa	43.50%
Pathology	42.50%
Haller's cells	33.50%
Uncinate process	33.50%
Variation in patency of osteomeatal complex	30.50%
Ethmoid bulla	81%
Deviatednasalsetum	31%
Conchabullosa	30.50%

Table 2: Prevalence of findings in Maxillary sinus Highest frequency of occurrence was observed with positive ostium Patency (82.5%) followed by ethomoid bulla (81%), septa 43.50%, pathology 42.50%, Haller's cells33.50%, uncinate process33.50%, variation in patency of osteo meatal complex30.50%, deviated nasal septa 31%, con chabullosa 30.50%.

Discussion

The paranasal sinuses are paired and symmetrical, air-filled cavities situated around the nasal cavity. Paranasal sinuses are found in three bones of the neuro cranium,

the frontal bone, ethmoid bone and sphenoid bone. The maxilla is the only facial bone that contains its own sinuses. The function of the paranasalsinuses is debated.However, they are believed to be implicated in several roles: decreasing the relative weight of the skull,increasing the resonance of the voice, providing a buffer against facial trauma, insulating sensitive structures from rapid temperature fluctuations in the nose, and humid ifying and heating in spired air. Furthermore, they also play a role in immunologicaldefense.14 Lee J Hetal; in 2020 suggested that width was the only parameter that varied significantly between males and females and found a p value of population had the larger ostium diameter when compared to males.[21], these findings contradict our own. It was also observed that there was a significant variance between the different age groups when compared statistically in the ostium diameter of the study popu lation p=.000078. These findings in dictated that age changes clearly affected the ostium diameter. The significance of maxillary sinus ostium diameter was elaborated by Kirihene RK et al; in 2002, where they suggested that a larger ostium diameter correlated with a better overall sinus health.[21] Sheikh NN et al in 2018 also noted that there is no discernible variance between males and Females in terms of maxillary sinus in fundi bulum dia meter.22 These findings are in agreement with the present study. The present study was observed that there was a nonsignificant variance between the different age groups when compared statistically in the diameter of in fundi bulum of the study population p=.069374. Positive ostium patency was seen in 82.5% of all cases. Highest prevalence was in group 4. It is important for plannings in us augmentation procedure to evaluate the existence of a patent ostium. Only about 5% of all cases that have clinical symptoms like purulent discharge, postnasal drip, facial pain and head aches will have paten to stium [symptomatic MSH patients with a patentosteo meatal complex (MSHPO)], 95% of all sinusitis cases are associated with absence of patency in the maxillary ostium. These findings were elucidated by Jang YJ etalina 2012 study.[23] Lee JW et al in a 2016 study suggested that before sinus lifting, CT images are recommended to detect anatomic variants of the osteomeatal complex, they further added that if a disadvantage eousanatomic variant is detected, the use of nasal decongestants should be considered to reduce the risk of posto perative sinusitis.[24] Presence of septa was seen in 43.5% of all cases. Highest prevalence was in Group 5. Gülşen Uetal in 2015 suggested that the presence of septa, located at the inner surface of the maxillary sinus, increases the risk of sinus membrane perforation during asinus elevation for dental implant surgery [25]. Presence of pathology was seen in 42% of all cases. Highest prevalence was in Group 5. Ani CC et al in 2016 suggested that 23.6% of all population will have a presence of sinus pathology.26 Raghav M et al in 2014 found the incidence of incidental pathological findings in Cone Beam Computed Tomo graphy scans of the maxilla was 59.7%.27 Haller's cells was seen in 33.5% of all cases. Highest prevalence was in Group 4. Kamdi P et al in 2018 found that there was a 35% prevalence of Haller's cells in maxillary sinuses and in the cases where it was associated with maxillary in fundibulum compression, sub sequent sinus it is and pneumatisation followed[28]. Pneumatisation of the maxillary sinus is associated with difficulties in sinusaug mentation planning, as suggested by Cavalcanti MC etalin2018.29 Anatomical variations of Uncinate process was seen in 88.5% of all cases. Highest prevalence was in Group 4. Gungor G et al in 2016 suggested that uncinate process is the most important structure of OMC, both prevents

the direct contact of the inspired air with the maxillary sinus, acting like a shield, and play sarole in mucociliary activity.30 Kapoor PK et al in 2002 suggested that an under developed or absent uncinate process is indicative of maxillary sinus hypoplasia and results in infections and reinfections of the maxillarysinus.[31]

AL sufyani N, El-Hakim H and Major P in a 2021 study suggested that a hypoplastic maxillary sinus with abnormal or absent uncinate process is associated with advanced mucosal thickening and may present with altered anatomy of the lateral wall of the nasal cavity causing its approximation to the orbital floor, therefore making treatment planning complicated.[32] Variations in patency of osteomeatal complex was seen in 86.5% of all cases. Highest Prevalence was in Group 4. Shaikh Metal in 2020 suggested that presence of anato mi variants of the osteo meatal complex (OMC) is a common finding and at the same time the patency of the ostium is significant during sinus floor elevation procedures. Anatomic variants of the OMC mayo ccurina population ranging from 67% to 83.5%.[33] Anatomical variations of Ethmoid bulla was seen in 81 % of all cases. Highest prevalence was in Group 5. The incidence of anatomical variations of ethmoid bulla in the present study was 81 % subjects. Previous studies have reported a varied incidence of the same.[34] Deviated nasal septum was observed in 31% of all subjects. Highest prevalence was in Group 5. Obliteration of the osteomeatal complex was attributed to presence of deviated nasal septum in 76.2 % of all anatomic variants of the osteo meatal complex.[35] Concha bullosa was seen in 30.5%of all cases. Highest prevalence was in Group 5. Bandy o padhyay R et al in 2015 suggested that the incidence of an obliterated OMC was seen to be 30.5% of all cases that presented with this anatomic variant the authors further suggested that Concha bullosa is a common anatomic variant and does not require surgery. Its presence narrows down the OMC and can lead to subsequent sinusdisease.36 It is suggested that careful radiographic examination should be performed for patients undergoing sinus augmentation procedures. In the presence of anatomic variations of the OMC, the presence of anoblite rate dostium can be predicted, should be anti cipated, and if needed, be confirmed by endo scopic examination. This would help inorganizing better intra and postoperative care, which would prepare the surgeon and patient for a longer postsurgical inflammatory period and have an effect on the long-term success of the sinus graft. The limitations of the study are its relatively small size and retrospective study design, the evaluation of any variations existing in the left and right side of the sinus could also be done. Further studies should be performed with larger sample size, and an endoscopy could be performed for confirmation of radiological findings. The effect of patency of ostium should be thoroughly in vesti gated before sinus augmentation procedures asitis imperative for the success of implant.

Conclusion In this study, it is concluded that positive ostium patency was 82.5% of the sample size Cleary indicating that any sinus augmentation procedure undertaken will have a good prognostic value. Presence of septa was seen in 43.5% of cases. Pathology and Haller’s cells and any variation of deviated nasal septum concha bullosa may or may not affect the patency of ostium. We would like to lay emphasis on investigating for patency of maxillary sinus on augmentation procedures and implant procedures so that the chances off ailure are minimised. The clinical importance of patency of ostium and osteo meatal complex along with the various dimensions of maxillary sinus and associated anatomical variation which help clinician in planning

and predicting the overall long term prognos is of sinus augmentation procedures.

References

1. Whyte A, Boarding-house R. The maxillary sinus: physiology, development and imaging anatomy. Dento maxillofacial Radiology.2019 Dec;48(8):20190205.
2. Weber RK, Hosemann W. Comprehensive review on endo nasal endo scopic sinus surgery. GMS Current Topics in Otorhino laryngo logy - Head and Neck Surgery 2015; 14.
3. Mehra P, Murad H. Maxillary sinus disease of odontogenic origin. Otolaryngol Clin North Am. 2004; 37: 347 – 64
4. Kwak HH, Park HD, Yoon HR, Kang MK, Koh KS, Kim HJ. To pographicana to my of the inferior wall of the maxillary sinus in Koreans. Int J Oral Maxillo facial Surg.2004; 33:382–8
5. Plein-air Lana J, Moura Rodrigues Carneiro P, de Carvalho Machado V, Eduardo A lencarde Souza P, Ricardo Manzi F, Cam Polina Rebello Horta M. Anato mic variations and lesions of the maxillary sinus detected in cone beam computed Tomo graphy for dentalimplants. Clinic aL ora lim plants research. 2012 Dec; 23 (12): 1398-403.
6. Hauman CH, Chandler NP, Tong DC. Endodontic implications of the maxillary sinus: a review. Int Endod J. 2002; 35: 127–41.
7. Mamatha H, Sham Sundar NM, Bharathi MB, Prasanna LC. Variations of osteo meatal complex and its applied anatomy: a CT scan study. Indian J Sci Technol. 2010 Aug; 3 (8): 904-7.
8. Bolger WE, Parsons DS, Butz in CA. Paranasalsinus bony anatomic variations and mucosal ab nor malities: CT analysis for endos copic sinus surgery. The Laryngo scope.1991 Jan;101 (1): 56-64.
9. Liu X, Han D, Zhou B. Relationship between anatomic variations of nasal sinus and chronic sinusitis. Zhonghua ErBiYan Hou Ke ZaZhi.1998Jun1;33(3):149- 52.
10. Pignataro L, Mantovani M, Torretta S, Felisati G, Samba taro G. ENT assessment in the integrated manage Ment of Candi date for (maxillary) sinus lift. Acta Otorhino Laryngol Ital 2008; 28:110-9
11. Boyne P, James RA. Grafting of the maxillary sinus floor with auto genous marrow and bone. J Oral Surg 1980; 38:613–61
12. Boyne PJ, James RA. Grafting of the maxillary sinus floor with auto genous marrow and bone. J Oral Surg.1980 Aug; 38 (8): 613-6.
13. Del Fabbro M, Wallace SS, Testori T. Long-term implant survival in the grafted maxillary sinus: a systematic review. Int J Periodontics Restorative Dent. 2013; 33 (6):773–83.
14. Lee JH, Han WJ, Park JT. Three-dimensional CBCT based evaluation of the inferior part of the maxillary sinus: Retrospective Study. Scientific Reports.2020 Dec 3;10(1):1-9.
15. Hettiarachchi PV, Gunathilake PM, Jayasinghe RM, Fonseka MC, Bandara RM, Nana yakkara CD, Jayasinghe RD. Linear and Volumetric Analysis of Maxillary Sinus Pneumatization in a Sri Lankan Population Using Cone Beam Computer Tomo graphy. Bio Med Research International. 2021 Apr 8; 2021; 111 (3): 189–97
16. Paknahad M, Shahidi S, Zarei Z. Sexual Dimorphism of Maxillary Sinus Dimensions Using Cone-Beam Computed Tomo graphy. Journal of forensic sciences. 2017 Mar;62(2):395-8.
17. Abd-alla MA, Mahdi AJ. Maxillary sinus measure ments in different age groups of human cadavers. Tikrit Journal for Dental Sciences.2014;3(1).

18. Baweja S, Dixit A, Baweja S. Study of age related kk, I, changes of maxillary air sinus from its antero posterior, transverse and vertical dimensions using Computerized Tomo graphic (CT) scan. International Journal of Bio medical Research.2013; 4 (1):21-5.
19. Butaric LN, Wadle M, Gascon J, Pediatric Imaging, Neuro cognition and Genetics Study†. Anatomical variation in maxillary sinus ostium positioning: Implications for nasal - sinus disease. The Anato mical Record. 2019 Jun; 302 (6):917-30.
20. Peter SS, Nambiar P, Krishnan S, Al-Namnam NM. The Location and Diameter of the Primary Maxillary Sinus Ostium: A Cone-Beam Computed Tomo graphy Study in Malaysians. J. Int. Dent. Medical Res. 2020; 13 (4): 1365-9.
21. Kirihene RK, Rees G, Wormald PJ. The influence of the size of the maxillary sinus ostium on the nasal and sinus nitric oxide levels. American journal of rhinology. 2002 Sep;16(5):261-4.
22. Sheikh NN, Ashwin Irani SR, Suragimath G, Kumar KS. Evaluation of gender based on the size of maxillary sinus and frontal sinus using paranasal sinus view radiographs in Maharashtra population, India. Journal of Oral Research and Review. 2018 Jul 1; 10 (2):57.
23. Jang YJ, Kim HC, Lee JH, Kim JH. Maxillary sinus hypo plasia with a patentostio meatal complex: Athera peuticdi lemma. Auris Nasus Larynx. 2012 Apr1; 39 (2): 175-9.
24. Jang Won, Yoo JY, Paek SJ, Park WJ, Choi EJ, Choi MG, Kwon KH. Correlations between anatomicvariations of maxillary sinus ostium and posto peraive complication after sinus lifting. Journal of the Kore an Association of Oral and Maxillofacial Surgeons. 2016 Oct 1; 42(5):278- 83.
25. Gülşen U, Mehdiyev İ, Üngör C, Şentürk MF, Ulaşan AD. Horizontal maxillary sinussepta: An un common entity. International Journal of Surgery Case Reports. 2015 Jan1; 12:67-70.
26. Ani CC, Adoga AA, Tawe GS. Incidental maxillary sinus findings on cranial computerized tomographic scan in a tropical setting. Journal of the West African College of Surgeons.2016Apr;6(2):39.
27. Raghav M, Karjodkar FR, Sontakke S, Sans are K. Prevalence of incidental maxillary sinus pathologies in dental patients on cone-beam computed tomographic images. Contemporary clinical dentistry. 2014 Jul; 5 (3): 361.
28. Kamdi P, Nimma V, Ramchandani A, Rama swami E, Gogri A, Umarji H. Evaluation of Haller cell on CBCT and its association with maxillary sinus patho logies. Journal of Indian Academy of Oral Medicine and Radiology. 2018 Jan 1; 30(1):41.
29. Cavalcanti MC, Guirado TE, Sapata VM, Costa C, Pannuti CM, Jung RE, César Neto JB. Maxillary sinus floor pneumatization and alveolar ridge resorption after tooth loss: a cross – sectional study. Brazilian oral research. 2018 Aug 6;32.
30. Gungor G, Okur N, Okur E. Uncinate process variations and their relationship with ostio meatal Complex: a pictorial essay of multi dedector computed Tomo graphy (MDCT) findings. Polish Journal of Radiology. 2016;81:173.
31. Kapoor PK, Kumar BN, Watson SD. Maxillary sinus hypo plasia. The Journal of Laryn gology & Otology. 2002 Feb;116(2):135-7.
32. AL sufyani N, El-Hakim H, Major P. Prevalence of maxillary sinus hypoplasia and association withvariations in the Sino nasal complex: A cone beam CT study. Clinical Oral Investigations. 2021 Sep; 25 (9): 54 63-71.

33. Shaikh M, Kheur S, Kheur M, Lakha T, Sandhu R. Evaluation of the OMC and its relationship to patency of the maxillary ostium: ACBCT study. Clinical Oral Im plants Research.2020Oct;31:258-1.
34. Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G. Multi parametric statistical correlations between para nasal sinus anatomic variations andchronic rhino sinusitis. Acta Otorhino laryngo logica Italica.2012 Aug;32(4):244.
35. Sandhu R, Kheur MG, Lakha TA, Supriya M, Valentini P, Le B. Anatomic variations of the osteo meatal complex and its relationship to patency of the maxillary ostium: A retrospective evaluation of conebeam computed tomography and its implications for sinusaug mentation. J. Indian Prostho dont. Soc. 2020 Oct; 20 (4):371.
36. Bandyopadhyay R, Biswas R, Bhatta cherjee S, Pandit N, Ghosh S. Osteo meatal complex: A study of its anatomical variation among patients attending North Bengal medical college and hospital. Indian Journal of Otolaryngology and Head & Neck Surgery. 2015 Sep; 67 (3):281-6.