The Research Journal of Medical Sciences
[E-ISSN: 3078-2481| P-ISSN: 3078-2473]
Available on: https://rjmsonline.com/
Volume: 08 | Issue: 02, 2026
DOI: 10.5281/zenodo.21868058

*Research Article* *Open Access*

# Gender determination using maxillary sinus in Cone Beam Computer Tomography

**Dr. Indushree Saini[1], Dr. Rajeev Sharma[2], Dr. Vela D. Desai[3], Dr. Nidhi Chugh[4], Dr. Deepa Walia[5], Dr Puneet Bhargava[6]**

*[1]PG Student, Department of Oral Medicine & Radilogy, Jaipur Dental College & Hospital, Jaipur, Rajasthan.*
*[2]Professor & Guide, Department of Oral Medicine & Radilogy, Jaipur Dental College & Hospital, Jaipur, Rajasthan.*
*[3]Professor & Head, Department of Oral Medicine & Radilogy, Jaipur Dental College & Hospital, Jaipur, Rajasthan*
*[4,5,6]Professor, Department of Oral Medicine & Radilogy, Jaipur Dental College & Hospital, Jaipur, Rajasthan.*

**Corresponding Author**

**Dr. Indushree Saini**
PG Student, Department of Oral Medicine & Radilogy, Jaipur Dental College & Hospital, Jaipur, Rajasthan.

**Source of support**: Nil.
**Conflict of interest**: None

*Received: 12-07-2026*
*Accepted: 26-07-2026*
*Available online: 10-08-2026*



## Abstract

**Background:** Radiological identification of gender is employed when body is decomposed and fragmented. Various body parts are being used for gender determination such as skull, pelvis, long bones, foramen magnum, sella turcica, mandibular ramus, and paranasal sinuses in unknown remains.
**Aims& Objective:** This retrospective study aim to assess the reliability of morphometric measurements performed on the maxillary sinus for sex determination by using CBCT scans
**Material & Methods:** A hospital based observational study was carried out in the Department of Oral Medicine and Radiology at Jaipur Dental College and Hospital. CBCT scan images of 50 subjects who were referred for CBCT imaging of skull for various reasons and fulfilled our inclusion criteria were selected for the study.
**Results:** In the present study, total average area of the maxillary sinus was 6.66 ± 2.35cm$^2$ and the volume was 11.96 ± 5.18 mm. There is no significant difference between area and volume of maxillary sinus in different age groups. (P-value 0.92>0.05, P-value 0.34>0.05). The area of the maxillary sinus was more in males as compared to females and this was statistically significant. In the present study, out of 400 maxillary sinuses, 190 (47.5%) maxillary sinus showed septa. More number of pathologies in maxillary sinus were detected in males as compared to females. Maxillary sinus pathologies did not show predilection for any particular age group.
**Conclusion:** Maxillary sinus height was the best discriminating parameter for forensic identification with an overall accuracy ranging from 70% to 80%. Conclusions: Maxillary sinus measurements revealed anatomic variability between genders, and this approach can be applied as a complementary method for human identification.

***Keywords:*** *maxillary sinus, cone-beam computed tomography (CBCT), gender, forensic identification.*

## INTRODUCTION

Forensic science is the application of science to criminal and civil laws. Forensic identification of a human body or remains will be relied on by the prosecution in a criminal trial. Gender and age estimations are challenging and important procedures in the identification of unknown skull. Gender determination is part of forensic odontology and it is very important especially when natural calamities, mass disasters, and crime occur where forensic investigator receives unknown skeletal remains[1–3].

Radiological identification of gender is employed when body is decomposed and fragmented. Various body parts are being used for gender determination such as skull, pelvis, long bones, foramen magnum, sella turcica, mandibular ramus,

and paranasal sinuses in unknown remains. But in many instances these bones were recovered either in a fragmented or incomplete state where gender determination is difficult to perform. So, it is key to use denser bones that are often recovered intact such as maxillary sinuses[4–6].The maxillary sinus is the largest of paranasal sinuses located in the body of maxilla. The sinus develops at 10 weeks of intrauterine life and it is first to develop. It opens in the middle nasal meatus of the nasal cavity. At birth size is of pea and enlarges after eruption of deciduous teeth and again, with permanent teeth and with the completion of the eruption of the third molars, the pneumatization of the sinus ends. Szilvassy suggested various shapes of maxillary sinus, that is, triangular, leaf, scapular, and renal shaped. It has been reported that triangular sinuses were the most common in both females and males[7]. It varies greatly in size, shape, and position not only in different individuals but also in different sides of the same individuals. Hence maxillary sinus can be used for gender determination. Sinus radiography has been used for identification of remains and determination of gender. It has been reported that CT scans are excellent imaging modality in the identification of unknown remains as they provide an accurate assessment of the paranasal sinuses and craniofacial bones[8]. CT measurements of maxillary sinuses, that is, length, width, height, and volume, may be useful for supporting gender determination in forensic medicine. The aim of this study is to assessing the reliability of morphometric measurements performed on the maxillary sinus for sex determination by using CBCT scans.

**MATERIALS AND METHODS**

A hospital based observational study was carried out in the Department of Oral Medicine and Radiology at Jaipur Dental College and Hospital. CBCT scan images of 50 subjects who were referred for CBCT imaging of skull for various reasons and fulfilled our inclusion criteria were selected for the study.

Ethical clearance was obtained from the Ethics committee of the institution. CBCT head was performed using CS Carestream 8200. (figure 1) All the scans were made at high-resolution 3D images of up to 75 microns.

Four groups were formed according to age, each comprising of 25 males and 25 females: Group 1: 20-29 yrs; Group 2: 30-39 yrs; Group 3: 40-49 yrs;Group 4: 50-59 yrs

**INCLUSION CRITERIA**

1. CBCT scans of patients above 20 years of age showing maxillary sinus completely and bilaterally.
2. The data consisted of dentate and edentulous patients.

**EXCLUSION CRITERIA**

1. CT images of patients with edentulous posterior region.
2. Patients below 20 years of age
3. Patients with history of trauma to the maxillary sinus
4. Patients with history of surgery in the maxillary sinus region.

Informed Consent- Each participant will be informed about the study verbally in order to take the initial approval of participation. Then, they will be provided with the patient information sheet which clarified the nature of the study in the form of sequence of questions and answers.

**STATISTICAL ANALYSIS:**

The data on maxillary sinus parameters was obtained on 50 subjects. The frequency distribution according to age and gender was obtained, also the descriptive statistics like mean, standard deviation and range for demographic parameters were obtained. These descriptive statistics were obtained for maxillary sinus and foremen magnum parameters. The comparison of each parameters between males and females was performed by student 't' test and also the comparison between different age groups was performed using one way ANOVA test. The anatomical variations were analyzed using chi-square test. The entire analysis was performed using SPSS Software(Version26.0) with validated scripts and excel. The statistical significance was tested at 5%.

**RESULTS**

CBCT scan images of 50 subjects who were referred for CBCT imaging of skull for various reasons and fulfilled our inclusion criteria were selected for the study.

Over all mean area and volume was 666.3 ± 235.81mm2 and 11966.5 ± 5188.34mm3 respectively. In group 1 area was 645.89 ± 191.15mm2 while volume was 11653.03 ± 5206.9mm3, in group II area was 778.23 ± 285.06mm2 and volume was 14533.65 ± 6885.131mm3. In group III and group IV area were 776.38 ± 227.78mm2 and 657.78± 1 91.33mm2 respectively while volume were 13763.71 ± 4684.68mm3 and 15428.62 ± 5671.622mm3 respectively. P-value (0.92>0.05), there was no significant difference between area of PSAA for different age groups. P-value (0.34>0.05), there was no significant difference between volume of PSAA for different age groups.( Table1)

Table 1 A&B describes the mean area & volume of MS according to gender. Mean area & volume were significantly high among male as compare to female.(P<0.05)

Out of 400 maxillary sinus, 190(47.5%) maxillary sinus had septa. 93(48.95%) sept as were present on right side, and 97(51.05%) sept as were present on left side. In group I and III, total sept as present were 48. In group II total sept as present were 49 while in group IV it were 45. As p-value (0.07>0.05),(0.058>0.05) therefore right and left sept as are insignificant of age groups. (Table2)

Table 2 A describes percentage of presence of sept as in male patients according to side. 93 (46.5%) maxillary sinus had septa in male patients. 53(56.9%) sept as were present on right side and 40(43%) on left side in males. On right side, group IV had 15 sept as , followed by group I (14) and group II and III as (12) each. On left side, group III had 14 sept as, followed by group II (12), group I (8) and group IV (6). Table 2 B describes percentage of presence of sept as in female patients according to side. Around 97(48.5%) sept as were present in female patients. 40(41.2%) sept as were present on right side and 57(58.7%) on left side in females. On right side, all groups had 10 sept as. On left side, group I had 16 sept as followed by group II (15), then group IV (14) and group III (12). (Table2 A& B)

Table 3 describes overall pathology present according to age group. Out of 400 maxillary sinus, pathologies were seen in 159(39.75%) maxillary sinus. In group III 55, maximum pathologies were present. In group I 31 pathologies were present, in group II and group IV 35 and 38 pathologies were present respectively. 101(63 %) mucositis were present in total number. Polyp 22(13.83%) were fewer as compared to mucositis and sinusitis 36(22.64%). Here p-value (0.06>0.05) which showing significant difference between all the pathologies according to age. (Table3)

Table 3 A shows overall pathology present in male patients. In group III, maximum pathologies 29 were present followed by group IV 26, group I 22 and group II 21. Around 70(70.7%) of mucositis were found in male patient, 20(20.2%) of sinusitis and 9(9.09%) of polyp were present in males. p-value is (0.0006), there was significant difference between different pathologies in male. Table 3 B describes overall pathology present in female patients. Group III had maximum pathologies (25) followed by group II(14), group IV (12) and group I(9). 31(51.66%) of mucositis were present, 16(26.66%) sinusitis and 13(21.66%) of polyp. P-value 0.002, which shows significant difference between pathologies in female patients. ( Table3A&B)

**Table 1: Variation of area (in $mm^2$) and volume (in $mm^3$) of MS according to age**

| Age group | Area | Volume |
|---|---|---|
| I | 645.89 ± 191.15 | 11653.03 ± 5206.9 |
| II | 778.23 ± 285.06 | 14533.65 ± 6885.131 |
| III | 776.38 ± 227.78 | 13763.71 ± 4684.68 |
| IV | 657.78 ±1 91.33 | 15428.62 ± 5671.622 |
| Total | 666.3 ± 235.81 | 11966.5 ± 5188.34 |
| P-value* | 0.92(NS) | 0.34(NS) |

**Table 1.A : Mean area of MS according to gender**

| Age group | Male | Female | *P-value |
|---|---|---|---|
| I | 1123.20 + 2318.03 | 708.03 + 203.40 | 0.025(S) |
| II | 792.14 + 239.10 | 718.28 + 214.76 | 0.013(S) |
| III | 777.19 + 271.44 | 687.57 + 218.29 | 0.039(S) |
| IV | 687.85 + 274.72 | 649.07 + 189.31 | 0.021(S) |

**Table 1 B: Mean volume of MS according to gender.**

| Age group | Male | Female | *P-value |
|---|---|---|---|
| I | 15165.94 + 6141.53 | 12850.82 + 4400.01 | 0.034(S) |
| II | 14828.36 + 5388 | 12812.47 + 4633.09 | 0.024(S) |
| III | 13853.2 + 6878.14 | 12089.57 + 4049.11 | 0.16(NS) |
| IV | 12340.74 + 6176.5 | 11678.9 + 3979.85 | 0.42(NS) |

**Table 2: Percentage of septa present on right and left side of maxillary sinus according to age group.**

| | Septa | | |
|---|---|---|---|
| Age groups | Right | Left | Total |
| I | 24 | 24 | 48 |
| II | 22 | 27 | 49 |

| | | | |
|---|---|---|---|
| **III** | **22** | **26** | **48** |
| **Iv** | **25** | **20** | **45** |
| **Total** | **93** | **97** | **190** |
| **Percentage** | **48.95** | **51.05** | **47.5** |
| ***p-value** | **0.07(NS)** | **0.058(NS)** | |

**Table 2.A: Percentage of presence of septa in male patients according to side.**

| Age groups | Right | Left | Total | Percentage |
|---|---|---|---|---|
| **I** | **14** | **8** | **22** | **23.6** |
| **II** | **12** | **12** | **24** | **25.8** |
| **III** | **12** | **14** | **26** | **27.9** |
| **IV** | **15** | **6** | **21** | **22.5** |
| **Total** | **53(56.9%)** | **40(43%)** | **93(46.5%)** | |

**Table 2.B: Percentage of presence of septa in female patients according to side.**

| Age groups | Right | Left | Total | Percentage |
|---|---|---|---|---|
| **I** | **10** | **16** | **26** | **26.8** |
| **II** | **10** | **15** | **25** | **25.7** |
| **III** | **10** | **12** | **22** | **22.6** |
| **IV** | **10** | **14** | **24** | **24.7** |
| **Total** | **40(41.2%)** | **57(58.7%)** | **97(48.5%)** | |

**Table 3: Overall pathologies present according to group.**

| Age groups | Mocositis | Sinusitis | Polyp | Total |
|---|---|---|---|---|
| **I** | **15** | **13** | **3** | **31** |
| **II** | **22** | **4** | **9** | **35** |
| **III** | **41** | **9** | **5** | **55** |
| **IV** | **23** | **10** | **5** | **38** |
| **Total** | **101** | **36** | **22** | **159 (39.75%)** |
| **Percentage** | **63.52** | **22.64** | **13.83** | ***pvalue=0.06 (NS)** |

**Table 3.A: Overall pathologies present in male patients.**

| Age groups | Mocositis | Sinusitis | Polyp | Total |
|---|---|---|---|---|
| **I** | **11** | **8** | **3** | **22** |
| **II** | **16** | **2** | **3** | **21** |
| **III** | **25** | **3** | **1** | **29** |
| **IV** | **18** | **7** | **1** | **26** |
| **Total** | **70** | **20** | **9** | **99** |
| **Percentage** | **70.7** | **20.2** | **9.09** | ***p-value = 0.0006 (S)** |

**Table 3.B: Overall pathologies present in female patients**

| Age groups | Mocositis | Sinusitis | Polyp | Total |
|---|---|---|---|---|
| **I** | **4** | **5** | **0** | **9** |
| **II** | **6** | **2** | **6** | **14** |
| **III** | **16** | **6** | **3** | **25** |
| **IV** | **5** | **3** | **4** | **12** |
| **Total** | **31** | **16** | **13** | **60** |
| **Percentage** | **51.66** | **26.66** | **21.66** | ***pvalue=0.002(S)** |

## DISCUSSION

Maxillary sinus is the largest of all the air sinuses and grows very rapidly as the permanent teeth erupt until 15 to 20 years of age. After this age the size of the maxillary sinus usually remains static. But if the posterior teeth are extracted due to any reason there is inferior expansion of the maxillary sinus causing increase in the area and volume of maxillary sinus[9]. Inadequate bone volume due to alveolar bone resorption in association with pneumatization of the maxillary sinus often causes difficulty while implant placement for replacement of teeth. To increase the bone volume, sinus lift surgeries are performed using lateral approach and by alveolar ridge approach. Recently, maxillary sinus bone graft using the alveolar

ridge approach has been increasingly used with the development of equipment, but it is hard to secure a clear view and if the amount of residual bone is insufficient, the survival rate of this approach is low. Therefore, the lateral approach has been widely used as a much stabler and predictable maxillary sinus bone graft[5].

The blood supply of the maxillary sinus is by three arteries namely, infraorbital artery (IOA), posterior superior alveolar artery (PSAA) and anterior superior alveolar artery. They are the branches of the maxillary artery that run into the lateral wall of the maxilla and supply the maxillary sinus and the Schneiderian membrane[10]. The introsseous branch of PSAA supplies the maxillary molar and maxillary sinus[11]. Since the maxillary sinus has a complex location and a rich blood supply it is very crucial to investigate it to avoid complications during and after surgeries which are discussed as under.

Many imaging techniques such as the conventional radiographic views like lateral cephalograms, panaromic radiography, Water's view were used for the assessment of maxillary sinus. But due to the disadvantages like superimposition of images and limited total visualization of the sinus, one should not rely upon them as a guide for the diagnosis and treatment. With the advent of newer imaging modalities like Computed Tomography(CT) and Cone Beam Computed Tomography(CBCT) it has been possible to obtain both two dimensional and three dimensional images.

The CBCT scan images of patients who had undergone CBCT imaging for any reason were included in the study. The study sample comprised of CT scan images of 200 subjects (100 males and 100 females) which were divided into following groups : group 1: 20-29 yrs , group 2: 30-39 yrs, group 3: 40-49 yrs and group 4: 50-59 yrs. Each group included 25 males and 25 females.

In the present study, total average area of the maxillary sinus was $6.66 \pm 2.35 cm^2$ and the volume was $11.96 \pm 5.18$ cm $^3$. In the studies conducted by Kanthem et al[9] , Ariji et al[13], Attia et al[14]and where they found larger area (8.5 to $10.2 cm^2$) and volume( 14cm3 to $31 cm^3$) of maxillary sinus. This discrepancy may be due to different geographical population used sample size collection and different methods of calculating the dimensions. The data which was automatically computed were 14-17% higher than the manually calculated volume38. (Table 1)

There is no significant difference between area and volume of maxillary sinus in different age groups. ( P-value 0.92>0.05, P-value 0.34>0.05). However according to Ariji et al[13] there was statistically significant difference among age groups, in which as age increased size of the maxillary sinus decreased. After birth, the maxillary sinus continues to pneumatize into the developing alveolar ridge as the permanent teeth erupt. At the age of 20 years with the completion of the eruption of third molars, pneumatization of sinus ends. The change in adult maxillary sinus volume with age isthought to be related to the presence or absence ofposterior maxillary teeth[17]. (Table 1). There was no significant difference observed between the area and volume of right and the left MS. Ariji et al[13], and Attia et al[14]; also found results similar to present study.

The area of the maxillary sinus was significantly more in males as compared to females. This was in accordance with the studies conducted by several Indian authors[1,17]. Whereas no significant difference was seen between males and females in the studies conducted by Ariji et al[13], Kawarai et al[15], Attia et al[14].This could be due to population variation as our study was carried out in Indian population.(Table 1).

Other complications that may interfere while performing surgeries are the anatomical variations of maxillary sinus which includes septas. The septae are composed of cortical bone and may be either complete or partial7. Septae can be seen in many patterns like complete horizontal, partial horizontal, complete perpendicular, partial perpendicular, single or multiple(2 or 3)[6]. Due to presence of septa, during the maxillary sinsus surgeries it can obstruct the proper visualization of the maxillary cavity so there are chances of membrane perforation.

In the present study, out of 400 maxillary sinus,190(47.5%)sinuses showedseptas. Whereas in the studies conducted by Sigaroudi et al[6] , Orhan et al[16] septas were found in the range of 55% to 69%. This difference could be due to the thickness of the imaging slice, septae may be missed if the slice thickness is more. (Table 2).

Overall maxillary sinuses of 97 (48.5%) females and 93(46.5%) males had septa which is almost equal for both the genders. Similar results were found by Orhan et al[16] where near about equal number of septas were seen in males and females. Whereas male predilection was seen in the study conducted by Havenil et al (54.5% males, 45.4% females) and female predilection were seen in the study conducted by Sigaroudi et al[6] (61.2% females, 38.8% males). This variation may be due to the different methodology used and variations in sample size and population.

In the present study, the number of maxillary sinus having septas were independent of the age group similar results were obtained by Orhan et al[16]. When compared among right and left, 93 septas (48.95%) were on right side while 97 septas

(51.05 %) were on left side. This is in accordance with other studies who also did not find any significant difference between right and left[7].(Table 2, Graph 2)

While viewing the maxillary sinuses one should look for other incidental findings like mucosal thickening, opacification, polypoid mass, neoplasms, etc. should be viewed in the imaging field. For dental implant site assessment in the maxilla, the configuration and status of the maxillary sinus is important to assess the available amount of bone. If a sinus lift is indicated, the visualization is useful, because the success rate of sinus lift procedures is crucially dependent on the configuration and status of the maxillary sinus. Hence, in order to avoid unnecessary treatment or provide appropriate treatment planning and follow-up, the significance of incidental pathologic findings should be clarified.
Although in the present study, out of all the 400 maxillary sinsuses, such incidental pathologies were seen in 159(39.75%), previous studies have only reported an occurrence of such pathologies in only 14% to 58%.(Table 3)
Such difference may be due to the difference in the sample size in different studies and differences in the population. Other reason could be due to use of different imaging modalities for detection of maxillary sinus pathologies.

The pathologies in the maxillary sinus like mucosal thickening (mucositis), polyps, opacification (sinusitis) were evaluated. Mucosal thickening is the thickening of more than 1 mm in any wall of the maxilla. Polypoid lesions are the homogenous round opacities with distinct demarcating boundaries at the base of the maxillary sinus. Complete opacification is the completely opacified maxilla in all axial and coronal slices suggestive of maxillary sinusitis[18]. Out of all the pathologies, mucositis was the most commonly seen 101(63.52%) followed by sinusitis 36(22.64%) and polyp 22(13.83%). The variation in the results may be due the slice thickness of 1 mm which was used in our study, this could also have influenced the high occurrence of mucosal thickening in our study. (Table 3).

Maxillary sinus pathologies did not show predilection for any particular age group (P value is 0.06>0.05). The studies conducted by Lim et al[18], also had the similar results. No significance of age could be due to the fact that the patients varied in age from 20 to 59 years of age and did not include patients under 12-years of age. The formation of their MS is still incomplete and certain abnormalities such as mucosal thickening and opacification are common findings in early childhood.(Table 3).

Total 76 pathologies were present on the right side while 83 were present on left side. There was significant difference between the pathologies on the right and the left sides. On right side mucositis (50) was maximally seen followed by sinusitis (17) and polyp (9). On left side mucositis (51) was maximally seen followed by sinusitis (19) and polyp(13). There is significant difference between males and females among different pathologies in maxillary sinus. Mucositis was seen in 70.7% of males and 51.66% of females. Sinusitis was seen in 20.2% of males and 26.66% of females, polyps were seen in 9.09% of males and 21.66% of females. On the contrary no significant difference in the occurrence of pathologies between males and females was observed by Malik et al[17]. The reason could be due to the difference in male and female sample size.

## CONCLUSION

In the present study, total average area of the maxillary sinus was $6.66 \pm 2.35 cm^2$ and the volume was $11.96 \pm 5.18$ mm. There is no significant difference between area and volume of maxillary sinus in different age groups. (P-value 0.92>0.05, P-value 0.34>0.05). The area of the maxillary sinus was more in males as compared to females and this was statistically significant. In the present study, out of 400 maxillary sinuses, 190 (47.5%) maxillary sinus showed septa. Overall 48.5% females and 46.5% of males had septa. When compared among right and left side of MS, 93(48.95%) MS had septas on right side while 97(51.05%) MS had septas on left side and found to be almost similar. There was statistically insignificant difference between the presence of septa among right and left side of maxillary sinus. More number of pathologies in maxillary sinus were detected in males as compared to females. Maxillary sinus pathologies did not show predilection for any particular age group.

## REFERENCES


1. Kanthem RK, Guttikonda VR, Yeluri S, Kumari G. Sex determination using maxillary sinus. Journal of Forensic Dental Sciences. 2015 May;7(2):163-167.
2. Ibrahim AA, Al Nakib LH. Location and Diameter of the Posterior Superior Alveolar Artery among Iraqi Subjects Using Computed Tomography.Journal of Dental and Medical Sciences.2016;15(9):80-84.
3. Uthman AT, Al-Rawi NH, Al-Naaimi AS, Al-Timimi JF. Evaluation of maxillary sinus dimensions in gender determination using helical CT scanning. Journal of Forensic Sciences. 2011 Mar;56(2):403-8.
4. German IJ, Buchaim DV, Andreo JC, Shinohara EH, Capelozza AL, Shinohara AL, Rosa Junior GM, Pereira M, Buchaim RL. Identification of the bony canal of the posterior superior alveolar nerve and artery in the maxillary sinus: tomographic, radiographic, and macroscopic analyses. The Scientific World Journal. 2015;2015:1-6.

5. Rahpeyma A, Khajehahmadi S. Open sinus lift surgery and the importance of preoperative cone-beam computed tomography scan: a review. Journal of International Oral Health: JIOH. 2015 Sep;7(9):1-7.
6. Sigaroudi AK, Kajan ZD, Rastgar S, Asli HN. Frequency of different maxillary sinus septal patterns found on cone-beam computed tomography and predicting the associated risk of sinus membrane perforation during sinus lifting. Imaging Science in Dentistry. 2017 Dec 1;47(4):261-7.
7. Sidhu R, Chandra S, Devi P, Taneja N, Sah K, Kaur N. Forensic importance of maxillary sinus in gender determination: a morphometric analysis from Western Uttar Pradesh, India. European Journal of General Dentistry. 2014 Jan 1;3(1):53-6.
8. Chaurasia BD. Human anatomy. Head, Neck & Brain. Temporal and infratemporal fossa.4th ed. CBS Publishers & Distributors; 2004(3). pp.147-49.(8)
9. Krennmair G, Ulm C, Lugmayr H. Maxillary sinus septa: incidence, morphology and clinical implications. Journal of Cranio-Maxillofacial Surgery. 1997 Oct 1;25(5):261-5.
10. Bornstein MM, Seiffert C, Maestre-Ferrín L, Fodich I, Jacobs R, Buser D, von Arx T. An analysis of frequency, morphology, and locations of maxillary sinus septa using cone beam computed tomography. Int J Oral Maxillofac Implants. 2016 Mar 1;31(2):280-7.(10)
11. Solar P, Geyerhofer U, Traxler H, Windisch A, Ulm C, Watzek G. Blood supply to the maxillary sinus relevant to sinus floor elevation procedures. Clinical Oral Implants Research. 1999 Feb;10(1):34-44.
12. Jasim HH, Al-Taei JA. Computed tomographic measurement of maxillary sinus volume and dimension in correlation to the age and gender (comparative study among individuals with dentate and edentulous maxilla). Journal of Baghdad College of Dentistry. 2013;25(1):87-93.(12)
13. Ariji Y, Ariji E, Yoshiura K, Kanda S. Computed tomographic indices for maxillary sinus size in comparison with the sinus volume. Dentomaxillofacial Radiology. 1996 Jan;25(1):19-24.(13)
14. Attia AM, El-Badrawy AM, Shebel HM. Gender identification from maxillary sinus using multi-detector computed tomography. Mansoura Journal of Forensic Medicine and Clinical Toxicology. 2012;1:17-28.
15. Kawarai Y, Fukushima K, Ogawa T, Nishizaki K, Gunduz M, Fujimoto M, Masuda Y. Volume quantification of healthy paranasal cavity by three dimensional CT imaging. Acta Otolaryngol (Stockh). 1999 Jan 1;119(540):45-9.(19)
16. Orhan K, Seker BK, Aksoy S, Bayindir H, Berberoğlu A, Seker E. Cone beam CT evaluation of maxillary sinus septa prevalence, height, location and morphology in children and an adult population. Medical Principles and Practice. 2013;22(1):47-53.(16)
17. Malik SS, Nasim A, Mohan RP, Kamarthi N, Goel S, Gupta S. Cone Beam Computed Tomography Analysis of Incidental Maxillary Sinus Pathologies in North Indian Population. Journal of Indian Academy of Oral Medicine and Radiology. 2017 Oct 1;29(4):278-81.
18. Lim CG, Spanger M. Incidental maxillary sinus findings in patients referred for head and neck CT angiography. Singapore Dental Journal. 2012 Dec 1;33(1):1-4.