ISSN: 0975-833X

*Available online at http://www.journalcra.com*

*International Journal of Current Research*
*Vol. 9, Issue, 12, pp.62849-62853, December, 2017*

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH**

## RESEARCH ARTICLE

# UTILITY OF PANORAMIC RADIOGRAPHS IN EVALUATION OF DISTANCES BETWEEN ROOT TIPS OF MAXILLARY MOLAR & FLOOR OF ANTRUM IN DIFFERENT CEPHALIC INDICES PATIENTS- A CROSS SECTIONAL COMPARATIVE STUDY

***,[1]Dr. Poulomi Bhakta, [2]Prof. (Dr.) Prashant Nahar, [2]Prof. (Dr.) Mohit Pal Singh, [2]Dr. Bhuvaneshwari, S., [1]Dr. Saurabh Goel and [2]Dr. Hemant Mathur**

[1]Department of Oral Medicine and Radiology, Pacific Dental College and Research Centre, Udaipur, Rajasthan
[2]Department of Oral Medicine and Radiology, Pacific Dental College and Hospital, Udaipur, Rajasthan

**ARTICLE INFO**

***Article History:***
Received 11th September, 2017
Received in revised form
18th October, 2017
Accepted 22nd November, 2017
Published online 27th December, 2017

***Key words:***
Maxillary Antrum,
Maxillary molars,
OPG,
IOPAR.

**ABSTRACT**

**Introduction:** Maxillary molar and their roots are significant due to their close vicinity to the maxillary sinus. Protrusion of the dental root apices into the sinus through the iatrogenic aperture can result in inflammation of the sinus mucosa initiating maxillary sinusitis. Through this study, statistically significant mean distance between maxillary sinus floor and root apices of maxillary molars in the patients of either cephalic indices using panoramic radiograph and intra-oral radiograph by paralleling technique is proposed, which will be helpful for treatment plan of the varied dental procedures done in the proximity of maxillary sinus floor.

**Aim:** To compare the distance between maxillary molar root tips and the maxillary sinus floor using panoramic and intraoral radiographic technique in different cephalic indices subjects.

**Methods:** The panoramic and intraoral radiographs from randomly selected 75 subjects, irrespective of gender from 18 – 47 years were selected, who were divided into three Groups i.e, Group I (18-27years), Group II (28-37years) & Group III (38-47years), each comprising of 25 subjects who were further clinically examined, analyzed &subdivided as Brachycephalic, Mesocephalic & Dolicocephalic in each group based on cephalic indices, were analyzed and the distance was assessed.

**Results:** Distance from the molar root tips to the floor of the maxillary sinus was significantly higher in Brachycephalic subjects than Dolicocephalic & normal populations of Group I (18-27years) and Group III (38-47years). In comparison between IOPAR and OPG among Brachycephalic, Mesocephalic & Dolicocephalic subjects in Group I, Group II & Group III, no statistical significance was found.

**Conclusion:** Higher distances between the molar root tips and the maxillary sinus floor could be expected in the brachycephalic than dolichocephalic & mesocephalic individuals of the age range of 18-27 years & 38-47 years. The Panoramic radiographs were useful in measuring the desired distance by close to IOPAR in patients of age range 18-47 years of either Cephalic indices.



**Citation: Dr. Poulomi Bhakta, Prof. (Dr.) Prashant Nahar, Prof. (Dr.) Mohit Pal Singh, Dr. Bhuvaneshwari, S., Dr. Saurabh Goel and Dr. Hemant Mathur, 2017.** "Utility of panoramic radiographs in evaluation of distances between root tips of maxillary molar & floor of antrum in different cephalic indices patients-A cross sectional comparative study", *International Journal of Current Research*, 9, (12), 62849-62853.

## INTRODUCTION

Maxillary molar and their roots are remarkable structures due to their close vicinity to the maxillary sinus.Maxillary sinus also known as Antrum of Highmore is the largest of paranasal sinuses; a 15 cc volume pyramid-shaped air filled osseous cavity situated within the body of maxilla (HamidrezaArabion *et al*., 2015; Dragan *et al*., 2014). In 80-100% of the population the maxillary sinus is free of microbial organisms or foreign bodies (Didilescu *et al*., 2012; Waite, 1971). This sterility may be compromised by direct invasion of infections or endodontic interventions within the molar and premolar teeth. Contamination of maxillary air sinus renders highly morbid infections as well as oroantral fistulae or root displacement caused by the molar and premolar teeth extraction and implantation (Nimigean *et al*., 2008). It was demonstrated by Wehrbein and Diedrich in 1992 that longer molar root projection into the maxillary sinus measured in panoramic radiographs results in greater amount of pneumatization and sinus expansion after extraction which effectively reduced the bone thickness in which implantation will be performed (Wehrbein and Diedrich, 1992). Protrusion of the dental root apices into the sinus results in direct spreading of infections during endodontic therapy or during extraction causing maxillary sinusitis (Hauman *et al*., 2002). Periapical surgical procedures of the upper molar teeth may be complicated by maxillary sinus wall aperture as described by Ericson *et al*. in

**Corresponding autor:* **Poulomi Bhakta,**
Department of Oral Medicine and Radiology, Pacific Dental College and Research Centre, Udaipur, Rajasthan.

18% patients undergoing periodontic surgeries of maxillary molar teeth (Hauman *et al*., 2002). Penetration of foreign bodies into the sinus cavity through the iatrogenic aperture can result in inflammation of the sinus mucosa initiating maxillary sinusitis process (Ericson *et al*., 1974; Jerome and Hill, 1995). Perforation of the sinus membrane is another potential complication of periapical surgeries in maxillary molar teeth (Persson, 1982). Cephalic index is the percentage of breadth to length in the skull. The index is calculated from measurement of the diameters of the skull. The length of the skull is the distance from the glabella (midpoint between the brows) and the most projecting point at the back of the head. The breadth of the skull is the distance between the most projecting points at the sides of the head, usually a little above and behind the ears. The cephalic index is the breadth multiplied by 100 divided by the length (SwapnaliKhair *et al*., 2013). Cephalic index has a close relationship with facial dimensions (Shukla *et al*., 2014). Enlargement of the maxillary sinus is consequent to facial growth. Growth of the sinus slows down with decline of facial growth during puberty but continues throughout life. Correlation of the distance between maxillary molar root tips and the maxillary sinus floor using OPG in subjects with various cephalic indexes was described by Arabion *et al* in 2015. This study demonstrated the distance was significantly higher in the brachycephalic groups than that of the mesocephalic, and the mesocephalic group showed longer distance in comparison to dolichocephalic subjects (HamidrezaArabion *et al*., 2015). The aim of the present study was to compare the distance between maxillary molar root tips and the maxillary sinus floor using panoramic and intraoral radiographic technique in different cephalic indices subjects.

## MATERIALS AND METHODS

This is a cross sectional comparative study andthe study was conducted in the Department of Oral Medicine& Radiology, Pacific Dental College & Hospital, Udaipur. The study population consisted of 75 subjects in the age range of 18 to 47 years of Indian origin residing in and around Udaipur City, Rajasthan of either gender with either cephalic indices selected randomly satisfy the inclusion & exclusion criteria.Prior to the study, Ethical clearance was taken from the Institutional Ethical Committee. Each of the subject was explained about the examination procedure and was included only after his/her written consent. Subjects eligible for study were as follow: having signed consent forms for participation in the study, having had a complete dentition in the maxilla and they were between 18-47 years old. Subjects were removed from the study if they had any pathologies of the maxillary sinus, history of pregnancy, maxillofacial trauma, orthognathic reconstructive surgery or oral surgical procedures in middle 1/3 rd of face, implant procedures in the posterior of the maxilla and radiographs with poor image quality, artifacts and untracable margins of maxillary sinus and root tips. A total number of 75 subjects, irrespective of gender from 18 – 47 years were selected, who were divided into three Groups i.e, Group I (18-27years), Group II (28-37years) & Group III (38-47years), each comprising of 25 subjects who were further clinically examined, analyzed & subdivided as Dolicocephalic, Mesocephalic & Brachycephalic in each group based on cephalic indices. Subsequently IOPA Radiograph of bilateral maxillary first & second molars and Panoramic Radiograph of each of the subject selected for the study was performed using ARDENT Intraoral X-ray machine & KODAK 8000C Digital Panoramic machine respectively. The Radiographs and Digital Image were subsequently processed and subjected to evaluation employing X-ray view box and Digital assessment (CPU, Monitor & Trophy DICOM Kodak Dental Imaging Software 6.12.10.0) methods for IOPA Radiograph & Panoramic Image respectively. The cephalic index (CI) was assessed by Hrdlicka's method (SwapnaliKhair *et al*., 2013). The measurements was taken with a mechanical engineering divider. The head length (L) was measured from glabella (point above the nasal root between the eyebrows and intersected by mid saggital plane) to inion(distal most point will be placed on the eternal occipital protuberance in the mid sagittal plane) and head width(W) was measured as the maximum transverse diameter between the two euryons (lateral most point placed on the side of the head).Cephalic index was measured by calculating the ratio of width of the head to the length of the head, multiplied by 100.

Cephalic Index (CI) = [Head width (W) / Head length (L)] X 100

The Cephalic index (CI) values under 75 was classified as DOLICOCEPHALIC, values of 75-80 was categorized as MESOCEPHALIC or normal populationand higher than 80 was classified as BRACHYCEPHALIC groups. Intraoral Periapical Radiographs were taken using ARDENT Intraoral X- ray Machine (70kVp, 10 mA) with paralleling technique. The radiographs were traced, using tracing paper, HB pencil and then distance between the floor of maxillary sinus and maxillary molar root tips was measured, using Digital Vernier Calipers. Panoramic image was taken with KODAK 8000C Digital Panoramic & Cephalometricsystem. The distance between root tips of maxillary molars to floor of the maxillary sinus in panoramic image was measured by Trophy DICOM Kodak Dental Imaging Software 6.12.10.0. The observations of distance between root tips of maxillary molars and floor of ipsilateral maxillary sinus thus obtained on either Radiographs were subjected to statistical analysis employing SPSS 16 and results obtained.

### Statistical Analysis

The statistical analyses were performed using the statistical package SPSS 16. The statistical analysis was carried out to evaluate and compare of these parameters in dolichocephalic, mesocephalic and brachycephalic subjects using unaired Student's t test and Chi-square test. P-values under 0.05 were considered as statistically significant values.

## RESULTS

In the present study, in Group I, 5 females (20.00%) & 4 males (16.00%) were Brachycephalic subjects, 2 females (8.00%) & 3 males (12.00%) were Dolicocephalic subjects and 6 females (24.00%) & 5 males (20.00%) were Mesocephalic subjects. In Group II, 2 females (8.00%) & 4 males (16.00%) were Brachycephalic subjects, only 9 males (36.00%) were Dolicocephalic subjects and 1 female (4.00%) & 9 males (36.00%) were Mesocephalic subjects. In Group III, 1 female (4.00%) & 3 males (12.00%) were Brachycephalic subjects, 1 female (4.00%) & 9 males (36.00%) were Dolicocephalic subjects and 5 females (20.00%) & 6 males (24.00%) were Mesocephalic subjects (Table 1). In the intergroup comparison of mean vertical distance in IOPAR among Dolicocephalic,

**Table 1.**

| | Brachycephalic | | Dolicocephalic | | Mesocephalic | |
|---|---|---|---|---|---|---|
| | F | M | F | M | F | M |
| Group I | 5 | 4 | 2 | 3 | 6 | 5 |
| | 20.00% | 16.00% | 8.00% | 12.00% | 24.00% | 20.00% |
| Group II | 2 | 4 | 0 | 9 | 1 | 9 |
| | 8.00% | 16.00% | 0.00% | 36.00% | 4.00% | 36.00% |
| Group III | 1 | 3 | 1 | 9 | 5 | 6 |
| | 4.00% | 12.00% | 4.00% | 36.00% | 20.00% | 24.00% |

**Table 2.**

| Iopar | Brachycephalic | | Dolicocephalic | | Mesocephalic | |
|---|---|---|---|---|---|---|
| | T value | P value | T value | P value | T value | P value |
| Group I / II | 1.440 | 0.174 | 0.756 | 0.464 | 0.489 | 0.631 |
| Group I / III | 2.488 | 0.038 | 0.532 | 0.602 | 1.468 | 0.159 |
| Group II / III | 1.193 | 0.267 | 1.663 | 0.115 | 1.935 | 0.068 |

**Table 3.**

| Opg | Brachycephalic | | Dolicocephalic | | Mesocephalic | |
|---|---|---|---|---|---|---|
| | T value | P value | T value | P value | T value | P value |
| Group I / II | 1.568 | 0.141 | 0.893 | 0.389 | 0.471 | 0.643 |
| Group I / III | 2.674 | 0.028 | 0.569 | 0.577 | 1.609 | 0.124 |
| Group II / III | 1.285 | 0.235 | 1.675 | 0.112 | 1.980 | 0.062 |

**Table 4.**

| Iopar/ opg | Brachycephalic | | Dolicocephalic | | Mesocephalic | |
|---|---|---|---|---|---|---|
| | T value | P value | T value | P value | T value | P value |
| Group I | 0.568 | 0.578 | 0.368 | 0.722 | 0.581 | 0.568 |
| Group II | 0.539 | 0.602 | 0.495 | 0.627 | 0.474 | 0.641 |
| Group III | 0.561 | 0.595 | 0.779 | 0.446 | 0.717 | 0.482 |

Mesocephalic & Brachycephalic subjects of Group I & Group II and Group II & Group III, no statistical significance was found. In comparison between Group I & Group III, statistical significance was found in Brachycephalic subjects ($p = 0.038$ i.e, $p<0.05$) whereas no statistical significance was found in Dolicocephalic&Mesocephalic subjects (Table 2). In the intergroup comparison of mean vertical distance in OPG among Dolicocephalic, Mesocephalic & Brachycephalic subjects of Group I & Group II and Group II & Group III, no statistical significance was found. In comparison between Group I & Group III, statistical significance was found in Brachycephalic subjects ($p = 0.028$ i.e, $p<0.05$) whereas no statistical significance was found in Dolicocephalic & Mesocephalic subjects (Table 3). In comparison between IOPAR and OPG among Brachycephalic, Mesocephalic & Dolicocephalic subjects in Group I, Group II & Group III, no statistical significance was found (Table 4).

## DISCUSSION

Cephalometry or measurement of human head is used in personal identification, forensic medicine, plastic surgery, orthodontics, archaeology and to examine the differences between races and ethnicities. The most important factors of Cephalometric dimension are height and breadth of head that is used in cephalic index determination. Cephalic index is useful anthropologically to find out racial and sexual differences. It is important in anthropometric indices, in diagnostic knowledge and in the medico-legal cases of Forensic Medicine. The Cephalometric results can also be of great assistance while evaluating patients in various fields of medicine like Medical Imaging, Paediatrics, Cranio-facial Surgery and also for studying growth trends in various castes/races within a defined geographic zone (SwapnaliKhair *et al*., 2013). CI values of 75-80 are categorized as mesocephalic or normal population. Values under 75 are classified in dolichocephalic and higher than 80 as brachycephalic groups (HamidrezaArabion *et al*., 2015). Cephalic index has a close relationship with facial dimensions (Shukla *et al*., 2014). The measures used by Retzius — when applied to living individuals — are known as cephalic index, and when referring to dry skulls, cranial index.These indices are calculated by determining the ratio between maximum width and maximum length of the head. Both the cephalic and cranial indices are therefore measures related to the shape of the skull.One particularly significant factor regards evaluating the influence exerted by the head shape on the shape of the face, since the base of the skull is considered a primarily stable structure, from which the face develops in an inferior and anterior direction. The maxillary sinus is the first of the paranasal sinuses to develop, and its growth ends with the eruption of the third molars at approximately 20 years of age. The inferior sinus wall is a curved structure formed by the lower third of the medial wall and the buccoalveolar wall, and the floor is formed by the alveolar process of the maxilla. The adult sinus is variable in its extension. In about half of the population, (Sicher, 1975) the sinus floor extends between adjacent teeth or individual roots, creating elevations in the antral surface, commonly referred to as 'hillocks' (Waite, 1971). The roots of the maxillary premolar, molar and occasionally canine teeth may project into the maxillary sinus. Because of the implications this can have on surgical procedures, it is essential for clinicians to be aware of the exact relationship between the apical roots of the maxillary teeth and the maxillary sinus floor.Wehrbein and Diedrich (Williams *et al*., 1995) described a positive correlation between the length of root projection into the

maxillary sinus as observed on panoramic radiographs and the amount of pneumatization that occurs after extraction. Sinus expansion following extraction can greatly decrease the amount of bone height available for implant placement. A periapical or periodontal infection of the upper premolars and molars may spread beyond the confines of the supporting dental tissue into the maxillary sinus, causing sinusitis (Sicher, 1975). Endodontic therapy or extraction of these teeth can result in penetration, oroantral fistulae or root displacement into the sinus cavity (McGrowan *et al*., 1993). The relationship between the dental roots and the inferior sinus wall is known to influence orthodontic tooth movement and the intrusion or bodily movement of teeth across the sinus floor that occurs with orthodontic treatment has been shown to cause moderate apical root resorptionand a high degree of tipping (Williams *et al*., 1995). The present study was done to evaluate and compare the distance & relationship between maxillary molar root tips and the maxillary sinus floor using Intraoral Radiographic technique & Panoramic Radiograph in different Cephalic Indices subjects i.e Dolicocephalic, Mesocephalic& Brachycephalic subjects. Arabion *et al*. (2015) in his study, had used OPG to evaluate qualitative and quantitative relationship between first and second maxillary molar root-tips and maxillary sinus floor and compared the values among the Dolichocephalic, Brachycephalic & Mesocephalic subjects. This study showed the roots of the first molar had more distance to the maxillary sinus floor than the second molars in all groups.

These results were similar to those study conducted by Eberhardt *et al* (1992) & Pagin *et al* (2013). Also, Huang *et al* (2011) reported that the first molar roots had more risk to displace the maxillary sinus rather than other posterior teeth. In our study, the study population consisted of 75 subjects in the age range of 18 to 47 years. Out of 75 subjects, a total of 52 males (69.33%) and 23 females (30.67%) allocated in three study groups: dolichocephalic, mesocephalic, and brachycephalic; composed of 24, 32 and 19 subjects, respectively. Arabion *et al*. (2015) in his study, the study population consisted of 300 subjects in the age range of 15-45 years and Study population consisted of 149 males and 151 females allocated in three study groups: dolichocephalic, mesocephalic, and brachycephalic; composed of 99, 98 and 103 cases, respectively. Arabion *et al*. (2015) in his study, had mentioned the distance was significantly higher in the brachycephalic groups than that of the mesocephalic, and the mesocephalic group showed longer distance in comparison to dolichocephalic individuals. Farkas *et al* (2005) suggested the hypothesis that the change of cephalic index may affect maxillary vertical height and alter the distance between the maxillary sinus and the posterior teeth roots. Our study showeddistance from the molar root tips to the floor of the maxillary sinus was significantly higher in Brachycephalic subjects than Dolicocephalic & normal populations of Group I (18-27years) and Group III (38-47years). Several studies have been carried out to measure this distance in normal populations by using computed tomography (CT) and cone-beam computerized tomography imaging. Regarding the results achieved by Ali *et al* (2012), the mean distances measured by panoramic radiography were found to be significantly shorter than those measured in the same population by CT scan, but panoramic x-rays are equally informative as cone beam CT imaging. In our study, we chose taking advantage of panoramic radiographs due to lower radiation exposure and hazards to study population & IOPA radiographs due to lower radiation exposure, accuracy & standardization.

**Conclusion**

Based on the findings of results of the present study it can be concluded that Panoramic radiographs are useful in measuring the desired distance close to IOPAR in patients of age range 18-47 years of either Cephalic indices & either gender. Distances from the molar root tips to the floor of the maxillary sinus are significantly higher in Brachycephalic subjects than Dolicocephalic & normal populations of age range of 18 -27 years and 38-47 years. Through this study, statistically significant mean distance between maxillary sinus floor and root apices of maxillary molars in the patients of either cephalic indices using panoramic radiograph and intra-oral radiograph by paralleling technique is proposed, which will be helpful for treatment plan of the varied dental procedures done in the proximity of maxillary sinus floor.

**Further suggestions**

It is further suggested that CBCT can be used for the measurement of the distance between maxillary molar root tips and floor of the maxillary sinus, considering its potential to provide more accurate measurements devoid of projection geometry errors.

## REFERENCES

Ali SM, Hawramy FA. and Mahmood KA. 2012. The Relation of Maxillary Posterior Teeth Roots to the Maxillary Sinus Floor Using Panoramic and Computed Tomography Imaging in a Sample of Kurdish People. *Tikrit J Dent Sci*., 1:81-8.

Didilescu A, Rusu M, Săndulescu M, Georgescu C. and Ciuluvica R. 2012. Morphometric analysis of the relationships between the maxillary first molar and maxillary sinus floor. *Open Journal of Stomatology*, 2; 352-7

Dragan E, Rusa O, Nemţoi A, Melian G, Mihai C. and Haba D. 2014. Maxillary sinus anatomic and pathologic CT findings in edentulous patients scheduled for sinus augmentation. *Rev Med ChirSoc Med Nat Iasi*., 118:1114-21.

Eberhardt JA, Torabinejad M. and Christiansen EL. 1992. A computed tomographic study of the distances between the maxillary sinus floor and the apices of the maxillary posterior teeth. *Oral Surg Oral Med Oral Pathol*., 73:345-6.

Engstrom H, Chamberlain D, Kiger R. and Egelberg J. 1988. Radiographic evaluation of the effect of initial periodontal therapy on thickness of the maxillary sinus mucosa. *J Periodontol*., 59:604-698

Enlow DH. 1990. Facial growth. 3rd ed. Philadelphia: WB Saunders;.

Ericson S, Finne K. and Persson G. 1974. Results of apicoectomy of maxillary canines, premolars and molars with special reference to oroantral communication as a prognostic factor. *Int J Oral Surg*., 3;386-93.

Farkas LG1, Katic MJ. and Forrest CR. 2005. Anthropometric proportion indices in the craniofacial regions of 73 patients with forms of isolated coronal synostosis. *Ann Plast Surg*., 55:495-9.

Fuhrmann R, Bucker A. and Diedrich. 1997. Radiological assessment of artificial bone defects in the floor of the maxillary sinus. *DentomaxillofacRadiol*., 26:112-116

Hamidreza Arabion, Abdol Aziz Haghnegahdar, Yasamin Sadegi Ardekani, Reyhaneh Ebrahimi and Reza Tabrizi, 2015. Comparison of the Distances between the Maxillary Sinus Floor and Root-Tips of the First and Second Maxillary Molar Teeth Using Panoramic Radiography among Dolichocephalic and Brachycephalic and Mesocephalic Individuals; *JDMT*, Volume 4, Number 2, 4(2): 81-88.

Harrison DF. 1961. Oro-antral fistula. *Br J ClinPract*., 15:169-74.

Hauman CH, Chandler NP. and Tong DC. 2002. Endodontic implications of the maxillary sinus: a review. *IntEndod J*., 35;127-41.

http://dentfac.mans.edu.eg/files/english/pdf/handouts/Maxillary_Sinus.pdf

Huang IY, Chen CM. and Chuang FH. 2011. Caldwell-Luc procedure for retrieval of displaced root in the maxillary sinus. *Oral Surg Oral Med Oral Pathol Oral RadiolEndod*., 112:e 59-63

Jerome CE. and Hill AV. 1995. Preventing root tip loss in the maxillary sinus during endodontic surgery. *J Endod*., 21:422-4.

Kilic, Kamburoglu, Yuksel and Ozen, 2010. An Assessment of the Relationship between the Maxillary Sinus Floor and the Maxillary Posterior Teeth Root Tips Using Dental Cone-beam Computerized Tomography. *European Journal of Dentistry*, Vol.4.

McGrowan DA, Baxter PW. and James J. 1993. The Maxillary Sinus and its Dental Implications. 1st ed. London: Wright Co., 1-25.

Misch, CE. 1999. Contemporary implant dentistry. 2nd ed. St.Louis: CV Mosby Co, 76-194

Monkhouse S. 2006. Cranial Nerves Functional Anatomy. 2nd ed. New York: Cambridge University Press, 59

Nimigean V, Nimigean VR, Maru N, Salavastru DI, Badiţa D. and Tuculina MJ. 2008. The maxillary sinus floor in the oral implantology. *Rom J MorpholEmbryol*., 49;485-9.

Pagin O, Centurion BS, Rubira-Bullen IR. and Alvares Capelozza AL. 2013. Maxillary sinus and posterior teeth: accessing close relationship by cone-beam computed tomographic scanning in a Brazilian population. *J Endod*., 39:748-51.

Persson, G. 1982. Periapical surgery of molars. *Int J Oral Surg*., 11;96-100.

Shukla D, Bablani D, Chowdhry A, Thapar R, Gupta P, Mishra S. 2014. Dentofacial and cranial changes in down syndrome. *Osong Public Health Res Perspect*., 5 ;339-44.

Sicher, H. 1975. Oral anatomy. 6th ed. St Louis: Mosby.

SwapnaliKhair, Deepika Bhandari and Swati Wavhal, 2013. Study of Cephalic Index Among the Students of Mumbai Region; *Indian Journal of Applied Research*, Volume : 3 | Issue : 11.

Tank PW. 2005. Grant's Dissector. 13 ed. Philadelphia: Lippincott Williams & Wilkins, 198.

Waite DE. 1971. Maxillary sinus. *Dent Clin North Am*., 15; 349-68.

Wehrbein H. and Diedrich P. 1992. [Progressive pneumatization of the basal maxillary sinus after extraction and space closure]. *Fortschr Kieferorthop*., 53(2):77-83. German.

Wehrbein H. and Diedrich P. 1992. The initial morphological state in the basally pneumatized maxillary sinus–a radiological-histological study in man. *Fortschr Kieferorthop*., 53;254-62.

Williams PL, Bannister LH, Berry MM. *et al*. 1995. Gray's anatomy. 38th ed. New York: Churchill-Livingstone, 1239

*******