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ORIGINAL ARTICLE

Maxillary sinus involvement of maxillary third molars: An OPG study conducted at Dow International Dental College, Karachi.

Abdul Hafeez Shaikh[1], Sidratul Muntaha[2], Shaheen Ahmed[3], Syed Jaffar Abbas Zaidi[4]

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ABSTRACT… Objective: This study aims to evaluate the angulation, position, and impaction of the maxillary third molar and its proximity and relationship to the maxillary sinus assessed through dental OPGs. **Study Design:** Cross-sectional Analytical study. **Setting:** Department of Oral Surgery, Dow International Dental College, Dow University of Health Sciences. **Period:** November 2019 to February 2020. **Material & Methods:** Through convenience sampling, 1684 Orthopantograms were collected. Out of which 864 OPGs were selected and included in this study. From these OPGs, 1228 maxillary third molars were evaluated for their proximity to the floor of the maxillary sinus. **Results:** Most common relation of the maxillary sinus with third molar roots was in class II which is 0-2mm bone presenting between the root and the sinus unanimously between both genders. Most of the roots of maxillary third molars present within the maxillary sinus were found within the second and third decade of life in both genders. **Conclusion:** Dental OPGs present a cost-effective viable alternative to CBCT in the treatment planning of impacted maxillary upper incisors in combination with other radiographs. The findings of this study further strengthen the proposal of using dental OPGs in the diagnostic repertoire of impacted wisdom teeth in low resource settings.

Key words: CBCT, Maxillary Sinus, Maxillary Third Molar, OPG.

INTRODUCTION

Approximately more than 40% of this world's population has been claimed to have at least one wisdom tooth impacted.[1] Maxillary third molars have been considered relatively easy to extract by dentists as compared to mandibular third molars with little accompanying risk to adjacent structures. Nonetheless, some difficult to manage complications have been documented such as ankylosed third molar especially if it is alone standing molar, fracture of the tuberosity, rupture of the maxillary sinus floor, oro-antral communication, and palatal hemorrhage.[2]

Impaction is defined as a tooth that fails to achieve its ideal position in occlusion in its due time of the eruption. Causes for impaction of a tooth are multiple including the increased density of the overlying bone, lack of space, increased crown size, malocclusion, crowding of teeth, and late development and mineralization of third molars. Third molars are the most impacted teeth owing to their late development and eruption. Prevalence of third molar impactions has been recorded to be from 18% - 30% in different studies.[3,4] Complications associated with impacted teeth vary from infection of the overlying mucosa, severe odontogenic infections, temporomandibular pain dysfunction syndrome to cystic pathologies, and even neoplasms.[1,5]

Maxillary third molar impactions are quite similar to mandibular wisdom impactions as both are assessed on the depth of the impaction, angulations, and involvement of nearby structures. Many classifications have been devised for this evaluation such as Pell and Gregory's classification[6,7], winter's classification[8], maxillary sinus involvement depending on the presenting bone between roots of the molar and

1. BDS, M.Phil, FCPS, Associate Professor Oral Surgery, Dow International Dental College, Dow University of Health Sciences.
2. BDS, MDS Trainee, Dow International Dental College, Dow University of Health Sciences.
3. BDS, FCPS, Associate Professor Oral Maxillofacial Surgery, Dow International Dental College, Dow University of Health Sciences.
4. MD, MSc, MFDS RCPSG, MFD RCSI, FAIMER, Department of Oral Biology, Dow Dental College, Dow University of Health Sciences

Correspondence Address:
Dr. Syed Jaffar Abbas Zaidi
Dow University of Health Sciences.
jaffar.zaidi@duhs.edu.pk

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the sinus floor amongst others.

The rate of complication of wisdom tooth exodontia ranges from 2-30%.[9] Complications associated with the extraction of maxillary third molars include fracture of the maxillary tuberosity, hemorrhage due to damage to the greater palatine artery, oro-antral communication, displacement of the tooth or tooth structures into the adjacent facial space which is infratemporal space or the maxillary sinus.[10]

These complications are managed by oral maxillofacial surgeons as they are beyond the skill and expertise of general dentists. Some of these complications are managed under general anesthesia that may lead to significant morbidity in patients.[10]

Appropriate and comprehensive treatment planning is required to avoid these inadvertent and serious complications. This treatment planning includes clinical evaluation of the patient, adequate mouth opening, determination of ASA classification for patients, and radiographic assessment. Radiographic assessment will determine the angulation of the impacted wisdom, thickness of bone, and difficulty status of this wisdom tooth.[11] The type of impaction has a direct correlation with the degree of difficulty of the impacted tooth. Distoangular impactions of maxillary wisdom teeth have the least degree of difficulty of removal while mesioangular impactions have the highest degree of difficulty. Radiographic assessment is also performed to note the proximity of the maxillary third molar with the maxillary sinus floor or wall. Radiographic evaluation can be performed by periapical X-rays, Orthopantograms, and Cone Beam Computed Tomography (CBCT).[12]

Pneumatization of the sinus increases with age and thus higher incidence of sinus involvement has been recorded in older ages. Although there are limited reported prevalence studies of maxillary sinus proximity to the roots of the maxillary third molar[13], local studies are needed to ascertain the prevalence of maxillary third molars to the maxillary sinus as viewed from dental OPGs. Most of the dentists in Pakistan have access to Dental OPGs and the relationship of third molars with respect to the maxillary sinus can be assessed with ease.

MATERIAL & METHODS

This cross-sectional analytical study comprised of dental OPGs from patients aged from 20 years till 70 years, visiting the Oral Surgery department, Dow international Dental College, Karachi for the period of 5 months from November 2019 to February 2020. This study was exempted from ethical review Ref. No. ERC/3472/August/9/24. This non-invasive study was conducted in commonly accepted educational settings and was by ethical standards of the Helsinki Declaration. Informed consent was obtained from all the participants and anonymity and confidentiality of participants were guaranteed.

Convenience sampling was used in this study and the sample population included all those patients who were referred to the Oral surgery department and categorical classification and incidence of impaction were calculated by dividing into groups based on age, gender, and socio-economic status.

This study evaluated the proximity of the maxillary sinus to the maxillary third molar roots. The basis for the categorization of the sinus involvement has been made on the depth of impaction of the 3rd molar on Pell and Gregory classification level C having the closest proximity to the sinus and the measurement of bone between the sinus lining and the longest root of the 3rd molar. The depth of the impaction was measured in millimeters that corresponded to the depth of the bone between the roots of the third molar and the inferior wall of the sinus floor as shown in Figure-1.

RESULTS

The primary instrument of evaluation used for this research was OPG x-rays since it is the most conveniently acquired x-ray modality and is cost-effective for patients belonging to varying socio-economic statuses.

Through convenience sampling, 864

orthopantomograms were selected out of 1684. Exclusion criteria were based on primary and mixed dentition OPGs, maxillary third molars with underdeveloped roots, congenitally missing or extracted maxillary third molars, and broken down & decayed maxillary third molars.

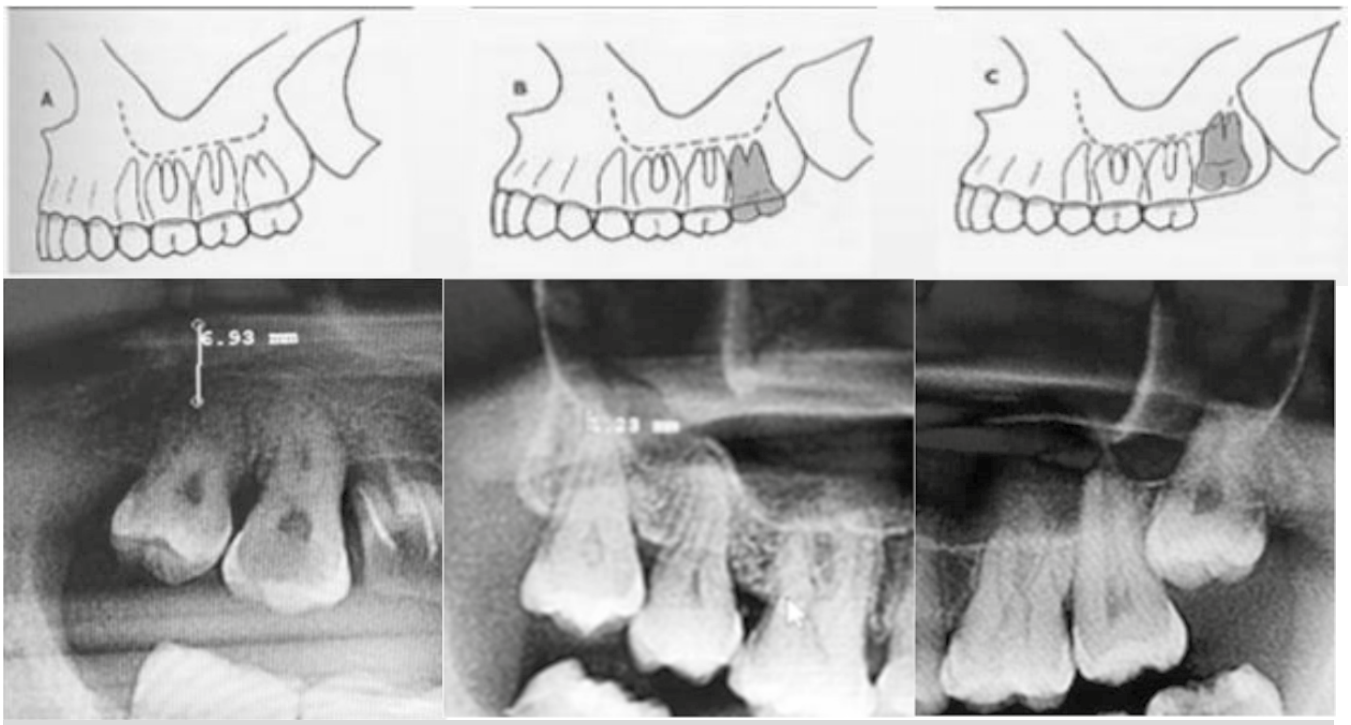
Out of these, gender division was made, and 511 females and 353 males were selected. A total of 1228 upper molars were evaluated including both genders. 783 maxillary third molars in females and 445 maxillary third molars in males were evaluated. Three groups were stratified based on the bone present between tooth roots and the sinus. Two millimeters or more bone between sinus lining and roots were classified into class I. Less than two millimeters till no bone between tooth or sinus wall was sorted into class II and class III was grouped with maxillary molar roots when presenting inside the sinus.

Further stratification was based on age. Five sub-groups were made with individuals belonging to their third decade of life, the fourth decade of life till the seventh decade of life. The last group represented patients in their sixties as shown in Figure-2 and Figure-3.

The most common relation of the maxillary sinus with third molar roots was in class II which is 0-2mm bone presenting between the root and the sinus unanimously between both genders as shown in Figure-2 and Figure-3. Most of the roots of maxillary third molars present within the maxillary sinus were found within the second and third decade of life in both genders as shown in Figure-2 and Figure-3.

DISCUSSION

One of the major predictors of success of maxillary third molar extractions is the amount of bone between the maxillary sinus floor lining and the roots of maxillary third molars.[1] Appropriate treatment planning for removal of maxillary third molars involves a radiographic assessment to evaluate the vertical alignment of the maxillary sinus with relation to the maxillary third molars, depth, and angulation of the maxillary third molars and their proximity to the maxillary sinus.[5]



The occlusal plane at same level The occlusal plane is between the The occlusal plane is as adjacent tooth occlusal plane & cervical line of apical to the adjacent tooth. adjacent tooth.

Figure-1. Pell & Gregory classification of maxillary third molars.

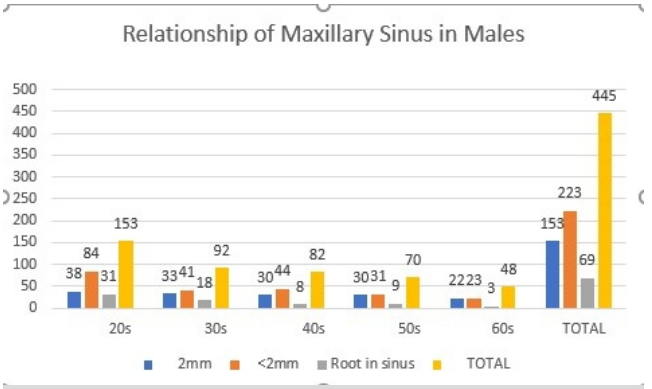


Figure-2. Relationship of maxillary sinus in males.

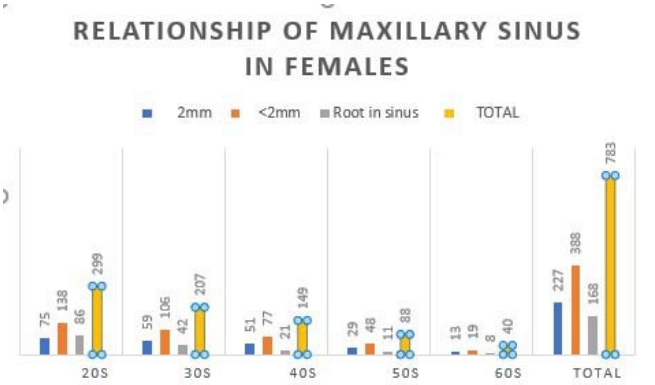


Figure-3. Relationship of the maxillary sinus in females.

CBCT provides a 3D assessment of the roots of maxillary third molars and its relationship with the maxillary sinus but its higher cost, more radiation, and lesser availability as compared to OPGs preclude its use as routine radiographic assessment especially in middle and low middle income countries.[14]

This study highlights that maxillary sinus involvement of the majority of maxillary third molars can be assessed through OPGs. Those maxillary third molars that are depicted by OPGs to be present in the sinus floor can be referred to oral surgeons. Perforation of the sinus floor during the extraction of the maxillary third molar can occur resulting in oro-antral communication.[15] Displacement of one or more roots of the maxillary third molar into the maxillary sinus or the pterygomaxillary space is also a recognized major complication of maxillary third molar removal.[9]

Detection of maxillary third molar roots in the maxillary sinus is fraught with diagnostic difficulties due to the distortion, superimposition of anatomical structures, two-dimensional views of OPGs as they lack accuracy in locating the inferior line of the maxillary sinus due to lack of cross-sectional views.[16]

Based on numerous studies, the depth of the impaction of the maxillary third molar is correlated with greater possibilities of oro-antral perforation and these impactions warrant comprehensive treatment planning including radiographic assessment.[17] The findings of these studies corroborate research from these studies.[13,14,18] Dental OPGs have historically been used for radiograph assessment of impacted wisdom teeth but recently have been replaced by CBCT.[13] OPGs remain cost-effective means of evaluating impacted wisdom if they are combined with other intra-oral radiographs.

The findings of this study correlate with well-established studies that have assessed the vertical angulations of maxillary wisdom teeth through OPGs.[17]

Further radiographic assessment through CBCT is warranted for maxillary third molars if their roots are detected to be in the maxillary sinus so that their accurate position, angulation, and thickness of underlying bone between the sinus floor and the roots can be evaluated.[1]

Cost-effective methods can be used where CBCT is not available such as using Buccal Object Rule and the use of OPGs with intra-oral radiographs.[13,19]

In this study, most of the wisdom teeth with roots in the sinus were found in the second and third decade of life. These findings are following several previous studies that reported that young individuals presented with a higher incidence of roots placed in the maxillary sinus.[20,21]

The most common relationship of the maxillary sinus with 3rd molar roots in this study was found to be in class II which is 0-2mm bone presenting between the root and the sinus unanimously

between both genders. This finding is in agreement with studies conducted by Kilic et, al in which the majority of the roots of the maxillary molars had no contact with the sinus floor.[22]

Older ages have a higher incidence of sinus involvement as reported in several studies owing to pneumatization of the maxillary sinus.[20,23] However, in this study higher incidence was noted in younger individuals, which could be attributed to racial differences and the absence of third molars in the elderly.

Treatment of maxillary sinus infections necessitates knowledge of topography, angulation, and the relationship between the root apex of the molar teeth and the inferior wall of the maxillary sinus.[24] The incidence of roots within the maxillary sinus decreases with age in this study. Although this finding is in contrast to research conducted by Kilic et al[22] this could be attributed to the difference in sample sizes, oral health care disparities, racial differences, and contextual findings that the majority of extractions take place during the second and third decades resulting in fewer teeth in the elderly.

The importance of treatment planning when OPG indicates the presence of molar roots in the maxillary sinus cannot be highlighted enough and in these cases, a presurgical CBCT is valuable and necessary to prevent any undesirable complications associated with sinus perforations.[25] The findings of this study implicate that dental OPGs can be used for stratification of patients undergoing maxillary third molar extraction as a cheap viable alternative to the more costly radiographic assessment by CBCT. Furthermore, dental OPG can be combined with intra-oral radiographs for confirming the presence of roots within the sinus.[13] CBCT provides a holistic view of the wisdom teeth, its horizontal and vertical angulations, the thickness of the bones between the sinus floor and the roots, and possibilities of reformatting cross-sectional images; all of which are not feasible through dental OPGs.[18,24,25] The higher cost of CBCT, higher radiation dose as compared to OPG, and its availability in only tertiary care hospitals preclude its routine use by dental clinics in middle and lower middle-income countries.

Limitations: For better validity of the inferences made regarding the relationship between the maxillary sinus and the maxillary third molar, CBCT could have been used for comparison. Future studies with comparison with CBCT and larger sample sizes should be conducted to ascertain the cost-effectiveness of using dental OPGs to investigate the relationship between the maxillary sinus floor and the maxillary third molars.

CONCLUSION

Dental OPGs present a cost-effective viable alternative to CBCT in the treatment planning of impacted maxillary upper incisors in combination with other radiographs. The proximity of the maxillary sinus to the roots of maxillary molars should be considered to minimize potential risks of sinus perforation. The findings of this study further strengthen the proposal of using Dental OPGs in the diagnostic repertoire of impacted wisdom teeth in low resource settings.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Abdul Hafeez Shaikh	Conceptualization of study design, data interpretation.	
2	Sidratul Muntaha	Data collection & Proof reading, Data analysis.	
3	Shaheen Ahmed	Write up & Literature search.	
4	Syed Jaffar Abbas Zaidi	Updated References, Proof reading and formatting.