

## Comparing 2D and 3D Imaging of the Relationship Between Maxillary Sinus and Posterior Teeth in Male and Female Individuals: A CBCT Study

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### Abstract

**Objective:** To assess the differences in the relationship between floor of maxillary sinus and posterior teeth roots using OPG and DVT in male and female individuals.

**Methods:** Two oral radiologists examined panoramic radiographs and Digital volumetric tomography (DVT) images obtained from 85 patients, in which 1,020 root apices were classified.

**Result:** Regression analysis was used to assess maxillary height in males and females.

**Conclusion:** The maxillary height of right and left second premolar and first and second molars on right side were higher in males. In females, left maxillary first molar and second molars and right maxillary second molar were higher in maxillary height.

**Keywords:** Maxillary Sinus Floor; Orthopantomograph; Digital Volumetric Tomography

### Abbreviations

2-D: Two Dimensional; 3-D: Three Dimensional; CBCT: Cone Beam Computed Tomography; DVT: Digital Volumetric Tomography; OPG: Orthopantomograph

### Introduction

In paranasal sinuses the maxillary sinus is larger than all other sinuses and situated in the body of the maxilla [1]. Base of the maxillary sinus is formed by the lateral wall of the nose, roof is formed by the floor of the orbit and apex is in the zygomatic process of the maxilla and giving rise to a unique pyramidal shape to the sinus [2]. Lateral hard palate and junction of anterior sinus wall and lateral nasal wall forms the floor of the sinus.

The floor of the sinus in an adult person is normally around 1cm below the floor of nasal cavity level. At age nine the floor of the sinus is generally at the level of nasal floor. As the maxillary sinus pneumatizes the floor continues to sink. The shape and configuration of the floor of the maxillary sinus are also extremely variable. As the age advances the cancellous bone between and above the alveolus can dehiscence so that the root tips project into the maxillary sinus. Sometimes they can cover only by an extremely thin lamella and sinus membrane.

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Maxillary molar roots region is the deepest region in the floor. In most cases the mean distance between the mesiobuccal root of second molar and sinus floor is less than 2 mm. The significance of this wall is related to its relationship to the roots of maxillary teeth and alveolar bony process. Occasionally the sinus extends in to alveolar process between roots of maxillary teeth so that part of socket protrudes into the sinus cavity [3].

Orthopantomograph in dentistry is used to evaluate maxilla and mandibular teeth and adjacent craniofacial skeleton for the proper diagnosis and treatment planning [4]. But formation of ghost images due to the object outside the image layer, superimposition of adjacent anatomical structures and magnification of the images leads to the limitation to evaluating the anatomic correlation between tooth roots and alveolar bone [5].

Cone beam computed tomography is developed in 1984 by Feldkamp, *et al.* This is a new imaging technique in the field of medicine. Where a cone shaped X-ray beam is used with 2-D detectors. In one scan includes one rotation around the object leads to the production of multiple series of 2-D images. These images are then re-constructed in to 3-D view [6].

### **Objective of the Study**

The objective of this study was to evaluate the relationship between the maxillary sinus and the apices of posterior teeth in male and female individuals as imaged by pairs of panoramic radiographs and DVT images in a relatively large sample.

### **Materials and Methods**

The present study comprises of 85 patients includes 49 male patient and 36 were females. Total 510 teeth (1020 roots) were assessed by 2 observers at an interval of 1 week. The age of the patients ranges from 18 - 45 years.

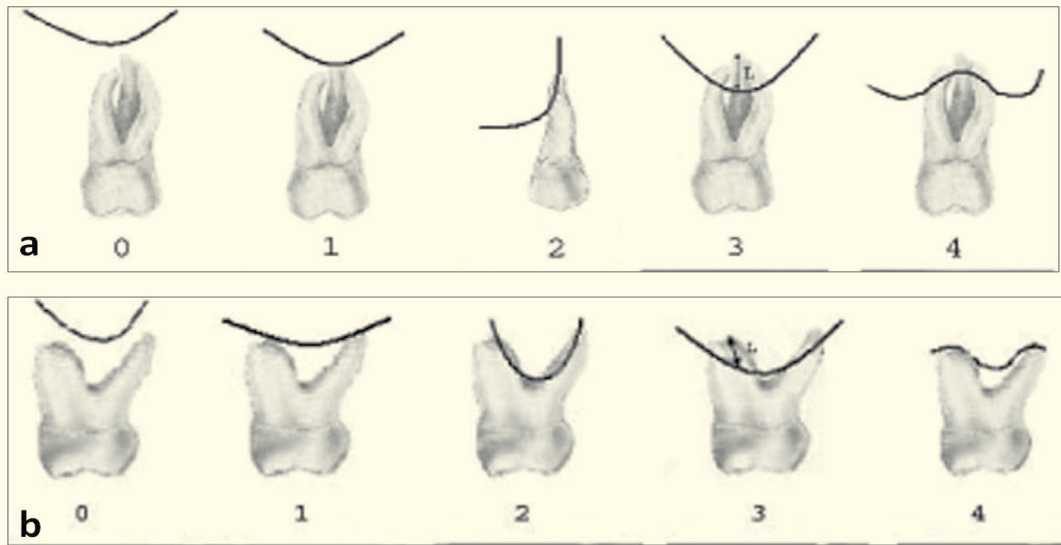
These 1020 roots were classified in to 5 categories using OPG and DVT. Mainly maxillary second premolar, first and second molars were selected in this classification [4].

The anatomical relationship between the floor of the maxillary sinus and maxillary teeth were classified into:

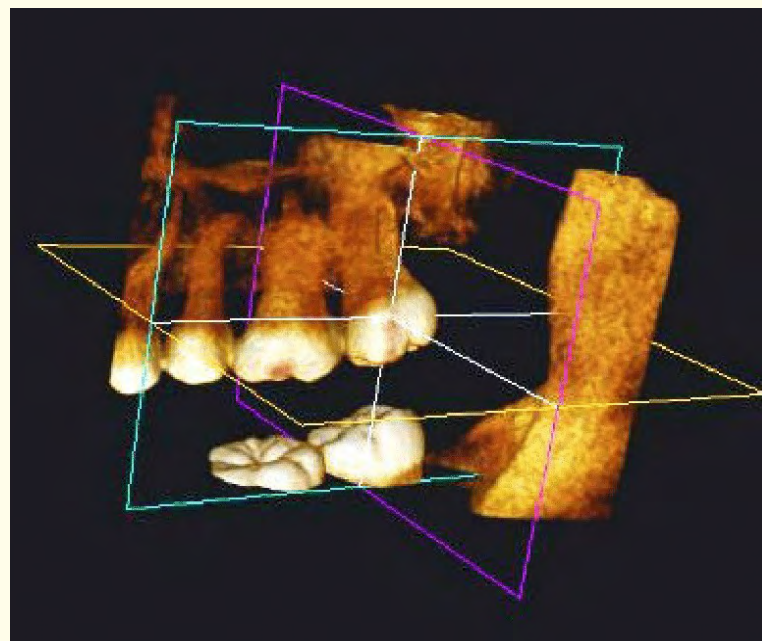
- 0: The root of the teeth is not in contact with the floor of the sinus.
- 1: Sinus floor is curved inferiorly and root is in contact with the floor of the sinus.
- 2: Sinus floor is curved inferiorly, but the roots are projected lateral to the sinus and apex is outside the sinus cavity.
- 3: Sinus floor is curved inferiorly, but the roots are projected inside the sinus.
- 4: Sinus floor is curved superiorly, and covers part or whole of the root (Figure 1) [4].

As per NCRP guidelines safety precautions like collimation, filtration, thyroid collar, lead apron and gonadal shield were used. The maximum permissible dose for radiation exposure was kept below of 2.4 mSv.

In this study all images were interpreted using Kodak Dental Imaging Software (Figure 2 and 3). The results of the study were subjected to following statistical analysis using SPSS 18.0 software. Regression analysis was used to assess the relative position of sinus floor in relation to maxillary posterior teeth in OPG and DVT in males and females.



**Figure 1:** Schematic illustrations of (a) panoramic images, (b) Digital Volumetric tomography of the 5 classifications of the maxillary posterior teeth roots in relationship to the inferior wall of the maxillary sinus).



**Figure 2:** Digital volumetric tomography 3D reconstruction maxillary teeth with floor of the sinus.

**Results**

Regression analysis shows there is a statistically significant difference between OPG and DVT in maxillary second premolar, both on the right and left side along with similar results on right first and second molars. No statistically significant difference seen on first and second molars of the left side (Table 1).

Tooth R		Right				Left			
		R Square	T	Sig	R	R Square	T	Sig	
2 <sup>nd</sup> Premolar	Constant (DVT)	.475	.226	3.738	0.001	.817	.668	-.494	0.624
	OPG			3.702	0.001*			9.716	0.000*
1 <sup>st</sup> Molar	Constant (DVT)	.602	.362	2.005	.051	.372	.138	3.470	.001
	OPG			5.165	.000*			2.743	.009
2 <sup>nd</sup> Molar	Constant (DVT)	.538	.290	1.575	.122	.375	.141	1.792	.080
	OPG			4.378	.000*			2.773	.008

**Table 1:** Relative position of sinus floor in relation to maxillary posterior teeth in Males.

Regression analysis shows there is statistically significant difference between OPG and DVT of the left first molar and second molars on both the sides. There is no statistically significant difference between OPG and DVT of the maxillary second premolar on both right and left side, along with right first molars (Table 2).

Tooth R		Right				Left			
		R Square	T	Sig	R	R Square	T	Sig	
2 <sup>nd</sup> Premolar	Constant (DVT)	.289	.083	6.187	0.000	.430	.185	2.806	.007
	OPG			2.069	0.044			3.268	.002
1 <sup>st</sup> Molar	Constant (DVT)	.403	.162	4.332	.000	.686	.471	1.204	.237
	OPG			2.492	.018			5.498	.000*
2 <sup>nd</sup> Molar	Constant (DVT)	.836	.699	-.647	.522	.640	.410	.839	.407
	OPG			8.864	.000*			4.859	.000*

**Table 2:** Relative position of sinus floor in relation to maxillary posterior teeth Females.

**Discussion**

In dentistry anatomical variations of the sinus floor’s depth, height, dimensions, shape, symmetry, relationship between the sinus floor to surrounding structures have importance during patient’s clinical management. Maxillary Sinus development is influenced by denti-

tion, chewing force, breathing movements and craniofacial growth [7]. The relationship with the maxillary sinus floor and maxillary teeth under normal conditions is formed through a thin layer of compact bone. The closer the apex of a tooth to the floor of the maxillary sinus, greater is the impact on the antral tissues, this being the most important cause of the infections of periapical and periodontal origin along with accidents in the process of extraction of teeth [8].

In this study the maxillary height in of maxillary second premolar on right and left side and first and second molars on the right side were higher in males than in females. However, in females, left maxillary first molar and second molars on right and left side were higher. There are several studies done in evaluation of maxillary sinus and maxillary teeth anatomy.

The maxillary height in first premolar and first molar region shows significantly high in men than in women. Lower zone of maxillary sinus floor is at the level of 2<sup>nd</sup> molar according to the study conducted by the Nimigean., *et al* [7].

Freisfeld., *et al.* did a study on maxillary first molars. In this study shows no relation to sinus floor topography and upper teeth [4].

Another study by Kwak., *et al.* using CT images, in which roots not contacting the sinus floor shows higher significance [9].

According to a study by Kilica., *et al.* using CBCT shows no statistically significant between right and left sides measurement of floor and posterior teeth or between female and male patients [10].

Maxillary premolars and molars and its roots have intimate relationship with maxillary sinus. Eberhardt., *et al.* proposed that apex of distobuccal root of maxillary second molar was closest to the floor of sinus and palatal root of first premolar was farthest from sinus floor. But kwak., *et al.* suggested that at the first premolar area distance between the apex of the buccal root and the buccoalveolar plate was the shortest and that on the mesiobuccal root was longest at the second molar area [9].

According to Killey and Key study the frequency of close proximity less than 0.5 mm between the roots of the posterior maxillary teeth and the sinus floor is 45.5% for the second molars, 30.4% for the first molars, and 19.7% for the second premolars.

60% of the roots of the maxillary first molars were closer to sinus floor is given by a study conducted by Ariji Y., *et al* [7].

The same author conducted a study where average the root projection length in the panoramic radiograph was 2.24 times larger than the actual root protrusion length in the DVT. The large difference between the 2 imaging techniques cannot be explained simply by the vertical magnification of the panoramic image because it is only 1.27% [11].

## Conclusion

The results of the present study suggest the following correlations between panoramic and DVT images:

1. The maxillary height of right and left second premolar and right side first and second molars higher in males compare to females.
2. In females, left maxillary first molar and second molars on right and left sides were higher in maxillary height.

This study helps in application of CBCT in dentistry for Pre-and post-implant assessment, jaw pathology including cysts, tumors and fibro-osseous lesions, Orthodontic treatment, wisdom teeth extraction and evaluation of facial trauma.

## Conflict of Interest

No Conflict of interest declared.

## **Source of Support**

Nil.

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