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Research Article

ASSESSMENT OF THE DISTANCE BETWEEN THE MAXILLARY SINUS FLOOR AND THE MAXILLARY FIRST AND SECOND MOLAR ROOT TIPS USING CONE-BEAM COMPUTED TOMOGRAPHY

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ABSTRACT
The aim of this study was to carry out the assessment of the distance between the maxillary sinus floor and the maxillary first and second molar root tips in Iranian population using Cone-beam computed tomography. In this cross sectional study 100 patients candidates for dental implants who had to take cone beam CT radiographs included the study. An oral and maxillofacial radiologist examined all images. The closest distance between each root tips and floor of maxillary sinus was recorded. K square testhad used to determine mean distance between root tips and sinus floor. The longest distance between maxillary sinus floor and maxillary posterior root tips belongs to mesiobuccal root of maxillary first molar (1.42 +- 0.72) and palatal root of maxillary second molar (1.42+- 0.83), the shortest distance belongs to distobuccal root of maxillary second molar (0.98+- 0.68) and the difference was significant (P<0.001). There is a close relationship between maxillary sinus floor and maxillary posterior root tips specially distobuccal root of maxillary second molar. When conducting tooth extraction or periapical surgeries more attention needs to avoid complications like sinusitis or oroantral fistula formation.

Keywords: *Maxillary Sinus, Molar, Tooth Root, Cone Beam Computed Tomography*

INTRODUCTION
The biggest and the first paranasal sinus to develop, is maxillary sinus and its close relationship to maxillary root tips is important for dental treatments (Shokri, 2014). The maxillary sinus floor formed by alveolar process of maxilla and the sinus dimensions is extremely variable (Hauman, 2002). The root tips of maxillary molars occasionally project into maxillary sinus, referred to 'hillocks' (Waite, 1971). True knowledge about the relationship between maxillary sinus floor and maxillary posterior root tips is essential in extraction, spread of infection from maxillary molars to sinus complex or endodontic surgeries and oroantral fistula formation in cases of tooth root protrusion in maxillary sinus, so the thickness of bone between the root tips and cortical plate of maxillary sinus floor can alter treatment planning (Vogiatzi, 2014; Watzek, 1997; Engstrom, 1988; Aviji, 2006). The best method for assessment of the sinus floor relation to maxillary posterior root tips is 3-D radiographs like Cone beam computed tomography (Bassam, 2010; Ok, 2014; Jung, 2012; Klic, 2010).
The aim of this study was to determine the relationship between the maxillary sinus floor and the maxillary first and second molar root tips using Cone-beam computed tomography.

MATERIALS AND METHODS
The cross sectional study comprised cone beam CT radiographs (Newtom VGI, Bologna, Italy and NNT Viewer software) that taken randomly from 100 patients candidates for dental implants who had visited a private dentomaxillofacial radiology center from 2011 to 2013. The inclusion criterion was any intact maxillary molar teeth and exclusion criteria were any pathologic condition related to maxillary posterior teeth or root canal treatments (Figure 1).

An oral and maxillofacial radiologist examined all images. The closest distance between each root tips and floor of maxillary sinus were recorded. K square tests were used to determine mean distance between root tips and sinus floor.

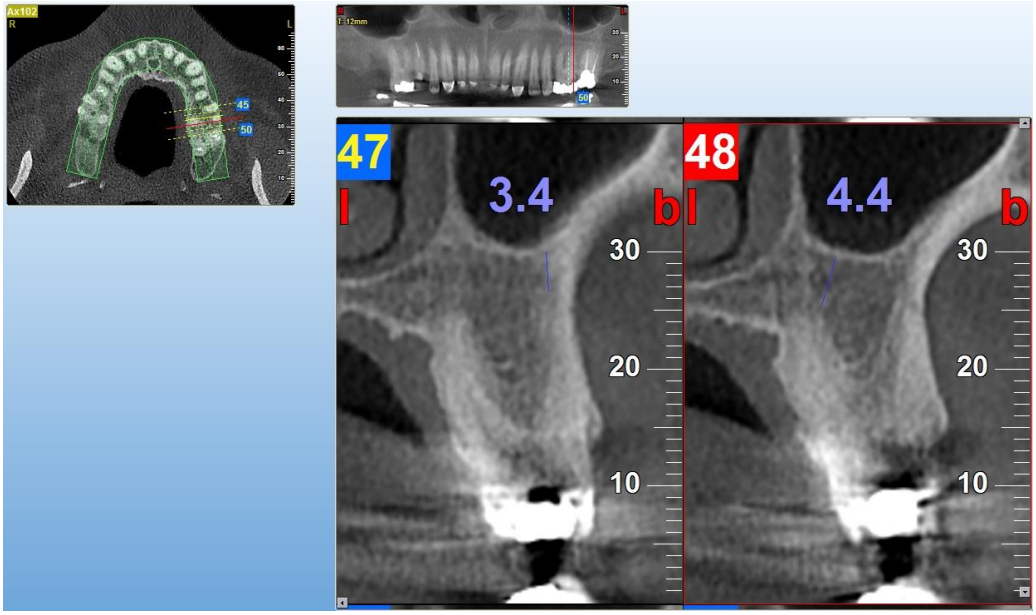

Figure 1: The Distance between Root Apices and Maxillary Sinus Floor

RESULTS AND DISCUSSION

Results

One hundred patients with mean age of 43.3 years were selected based on inclusion and exclusion criteria. The mean distance between the maxillary sinus floor and the maxillary first and second molar root tips, standard deviations, coefficient variation and minimum and maximum values are in Table 1.

The longest distance between maxillary molar root tips and maxillary sinus floor were mesiobuccal root tip of maxillary first molar (1.42 +- 0.72) and palatal root of maxillary second molar (1.42+- 0.83) and the shortest distance was distobuccal root of maxillary second molar (0.98+- 0.68) and the difference was significant (P<0.001).

The most coefficient variation belongs to distobuccal (DB) root of maxillary second molar (C.V=69) and the least belongs to mesiobuccal (MB) root of maxillary first molar (C.V=50).

The mean distance of maxillary sinus floor and MB root tips of maxillary fist molar was 30% more than maxillary second molar and the difference was significant (P<0.01). This distance for DB root of maxillary first molar was 29% more than maxillary second molar and the difference was significant (P<0.01). This distance for P root of maxillary first molar and maxillary second molar was not significant (P<0.4)

Table 1: Means, Standard Deviations (SD), Coefficient Variations (CV) and Minimum and Maximum (M&M) Values for First and Second Maxillary Roots

Tooth No.	Root	Mean+SD	C.V	M&M values
Maxillary First Molar	MB	1.43+0.72	50	1.6 _ 1.26
	DB	1.26+0.65	52	1.1 _ 1.42
	P	1.31+0.72	55	1.14 _ 1.48
Maxillary Second Molar	MB	1.1+0.63	57	0.95 _ 1.25
	DB	0.98+0.68	69	0.82 _ 1.14
	P	1.42+0.83	58	1.24 _ 1.6

Discussion

In this study we determined the close relationship between maxillary sinus floor and maxillary posterior root tips. The longest distance between maxillary molar root tips and maxillary sinus floor were mesiobuccal root tip of maxillary first molar and palatal root of maxillary second molar and the shortest distance was distobuccal root of maxillary second molar.

These results are important for whom conducting extraction or periapical surgeries so ordering a cone-beam CT in these cases are helpful (Vogiatzi, 2014; Wherbein, 1992; Arbel, 2006). The true understanding of the relationship between maxillary sinus floor and maxillary posterior root tips can not be determined by 2-dimentional radiographs as panoramic or periapical radiographs while 3-dimentional radiographs can show this relationship correctly (Bassam, 2010).

In this study we conducted cone-beam CT for measuring the distance between maxillary sinus floor and maxillary posterior root tips to avoid disadvantages of 2-dimentional radiographs such as superimpositions, horizontal and vertical magnification, distortion and lack of cross-sectional images (Bassam, 2010; Freisfeld, 1993).

Jung et al reported that the shortest distance between root tips and maxillary sinus floor belongs to buccal roots of maxillary second molars, comparable to result of our study (Jung, 2012).

Pagin *et al.*, (2013) reported 21% of maxillary posterior root tips coincides with maxillary sinus floor and 14.3% had projected to sinus space. The shortest distance between maxillary sinus floor and maxillary posterior root tips in that study belongs to mesiobuccal root of second maxillary molar that disagree with our results. This difference can be explained because of different population and geographic location (Asia-South America) between two studies (Pagin *et al.*, 2013).

There is numerous studies had measured the distance between maxillary sinus floor and maxillary posterior root tips (Shokri, 2014; Aviji, 2006; Ok, 2014; Klic, 2010; Arbel, 2006; Pagin, 2013). Some authors concluded that perforation of sinus membrane during periapical surgeries doesn't impair the outcome of surgery and healing of periapical bone (Persson, 1982; Ionnides, 1983), although with tooth extractions, complications may encountered during periapical surgeries include damage to the neighboring sinuses, spread of infections or oroantral fistula formation, so attention must paid to avoid sinus membrane perforation and introduction of foreign bodies into the maxillary sinus.

Numerous studies showed maxillary molars treated with periapical surgeries had aperture of wall or maxillary sinus floor and cause oroantral communications and secondary sinus infections (Watzek, 1997; Wallace, 1993).

Conclusion

There is a close relationship between maxillary sinus floor and maxillary posterior root tips specially distobuccal root of maxillary second molar. This anatomic variation is an important factor when conducting tooth extraction or periapical surgeries to avoid complications like sinusitis or oroantral fistula formation.

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The authors deny any conflicts of interest related to this study.

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