CBCT assessment of relationship between maxillary sinus floor and maxillary posterior teeth: A retrospective study

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Abstract
Introduction: Aim of the study was to assess the relationship between maxillary sinus floor and maxillary posterior teeth.

Materials and Methods: Retrospectively 50 cone beam computed tomographic images in the age group of 20 to 60 years were procured from CBCT archives randomly, based on the inclusion and exclusion criteria set forth for the study.

Results: Palatal root of right maxillary 1st premolar was farthest & mesiobuccal root of maxillary right 2nd molar was nearest to maxillary sinus (MS). Mean thickness of the distobuccal root for left maxillary 2nd molar with buccal cortical was maximum whereas mean thickness for the mesiobuccal root with buccal cortical plate for left maxillary 1st molar was minimum.

Conclusion: Adequate radiographic investigations are required before any surgical procedure in maxillary posterior teeth region. We recommend to use CBCT a 3-dimensional imaging modality when required.

Keywords: Cone beam computed tomography (CBCT), Maxillary posterior teeth, Maxillary sinus floor (MSF).

Introduction
During endodontic treatment, extraction and implant placement involving maxillary posterior teeth which are in close proximity to maxillary sinus (MS), the anatomical relationship between the floor maxillary sinus floor (MSF) and maxillary posterior teeth always pose a challenge in dentistry. Spread of infection from periapical region to MS can appear as a consequence of iatrogenic perforation as sinusitis.¹⁻³ It is affected by thickness of alveolar cortical plate and position of roots of maxillary posterior teeth in relation to MSF & determines the treatment planning.³⁻⁶

Imaging modalities involving conventional 2-dimensional radiography like intra oral periapical radiograph, panaromic radiograph & advanced imaging 3-dimensional radiography like CT imaging and CBCT have been used. CBCT is a preferred 3D imaging modality in maxillofacial region since it is a volumetric imaging modality which is ideal for capturing anatomic structures with less radiation exposure, cost effective, shorter acquisition time than CT. Hence, this study was undertaken with an aim to assess the relationship between MSF and maxillary posterior teeth using CBCT.

Materials and Methods
After getting approval from the institutional ethical committee the present study was conducted. 50 CBCT scans of bilateral maxilla were retrieved from the database after excluding the subjects with pathologies such as cysts, tumors, bone loss in maxillary posterior teeth region, evidence of fracture in maxillary posterior teeth region, showing errors and artifacts obscuring visibility of structures in the maxilla.

Radiographic Investigation
All images were assessed and measured using ONDEMAND 3D and Scanora software of the CBCT machine. Vertical relationship were classified into four types based on cross-sectional images.²⁻³ In built measurement tools were used to measure the distances. Bone thickness were measured to the corresponding alveolar cortical plate using CBCT.

Type 0: Location of MSF above root tip.
Type 1: MSF touches the root apex.
Type 2: MSF interposed between roots.
Type 3: Apical protrusion over the MSF.
Type 1 and type 3, were further classified into three types²⁻³
Type B: MSF lowest point located on the buccal root.
Type BP: MSF lowest point located between the buccal and palatal roots.
Type P: MSF lowest point located on the palatal side of the palatal root.

Fig. 1: ONDEMAND software showing coronal view, sagittal view, axial view and 3D view
Results

Intra and inter observer performances had moderate to excellent reliability with Intra class Coefficient ranging from 0.63 to 0.95. According to our study findings type 0 was most common in maxillary 1st premolars whereas type 3 was more common in maxillary 1st and 2nd molar (Table 2). Comparing the mean distance of different maxillary posterior teeth root to MSF between right & left side there was no significant difference (Table 3). Palatal root of right maxillary 1st premolar was farthest whereas mesiobuccal root of right 2nd molar was nearest to MS (Table 3). Comparing the mean thickness of respective cortical plate of maxillary posterior teeth between left & right side there was no significant difference (Table 4). Mean thickness of the distobuccal root for left maxillary 2nd molar with buccal cortical was maximum whereas mean thickness for the mesiobuccal root with buccal cortical plate for left maxillary 1st molar was minimum (Table 4).

Discussion

Among all paranasal sinuses the maxillary sinus (MS) is the largest sinus. In adults the extension of the MS is variable. Due to the close relationship between MSF and roots of maxillary posterior teeth accidental oro-antral communication can occur. Awareness among clinicians of the relationship between the roots of the maxillary posterior teeth and MSF is must. According to our study findings type 0 was most common in maxillary 1st premolars whereas type 3 was more common in maxillary 1st and 2nd molar (Table 2). Our study findings were in accordance with studies conducted by Abbas Shokri et al., Yun- Hoa et al., and Fry et al. Comparing the mean distance of different maxillary posterior teeth root to MSF between right & left side there was no significant difference (Table 3). Findings were in accordance with studies conducted by Abbas Shokri et al., Fry et al., Kilic et al. Palatal root of right maxillary 1st premolar was farthest whereas mesiobuccal root of maxillary right 2nd molar was nearest to MS (Table 3). Comparing the mean thickness of respective cortical plate of maxillary posterior teeth between left & right side there was no significant difference (Table 4). Our study findings were in accordance with studies conducted by Abbas Shokri et al., Fry et al., Kilic et al. Mean thickness of the distobuccal root for left maxillary 2nd molar with buccal cortical was maximum whereas mean thickness for the mesiobuccal root with buccal cortical plate for left maxillary 1st molar was minimum (Table 4).

Table 1: Age wise distribution among study subjects

| Variables | Category | n  | %   |
|-----------|----------|----|-----|
| Age       | 15-30 yrs| 31 | 62% |
|           | 31-45 yrs| 14 | 28% |
|           | 46-60 yrs| 5  | 10% |
Table 2: Distribution of vertical relationship of maxillary sinus with respect to different maxillary teeth

| Tooth No. | Type 0 | Type 1B | Type 1P | Type 1 BP |
|-----------|--------|---------|---------|-----------|
|           | n      | %       | n       | %         |
| Rt. 1PM   | 48     | 96%     | 1       | 2%        |
| Rt. 2PM   | 29     | 58%     | 10      | 20%       |
| Rt. 1M    | 21     | 42%     | 10      | 20%       |
| Rt. 2M    | 14     | 28%     | 11      | 22%       |
| Lt. 1PM   | 45     | 90%     | 0       | 0%        |
| Lt. 2PM   | 26     | 52%     | 9       | 18%       |
| Lt. 1M    | 13     | 26%     | 11      | 22%       |
| Lt. 2M    | 18     | 36%     | 12      | 24%       |

Table 2: Distribution of vertical relationship of maxillary sinus with respect to different maxillary teeth

| Tooth No. | Type 2 | Type 3B | Type 3P | Type 3BP |
|-----------|--------|---------|---------|----------|
|           | n      | %       | n       | %         |
| Rt. 1PM   | 0      | 0%      | 0       | 0%        |
| Rt. 2PM   | 0      | 0%      | 0       | 0%        |
| Rt. 1M    | 2      | 4%      | 3       | 6%        |
| Rt. 2M    | 4      | 8%      | 3       | 6%        |
| Lt. 1PM   | 0      | 0%      | 0       | 0%        |
| Lt. 2PM   | 0      | 0%      | 1       | 2%        |
| Lt. 1M    | 1      | 2%      | 2       | 4%        |
| Lt. 2M    | 0      | 0%      | 1       | 2%        |

Table 3: Comparison of mean distance (in mm) from different maxillary posterior teeth root apex to maxillary sinus b/w right & left side

| Root | Tooth No. | N  | Mean  | SD   | Mean Diff | Z    | P-Value |
|------|-----------|----|-------|------|-----------|------|---------|
| Buccal | Rt. 1PM | 50 | 5.65  | 3.52 | -0.39     | -1.064 | 0.29    |
|       | Lt. 1PM | 50 | 6.05  | 2.85 |           |       |         |
|      | Rt. 1PM | 49 | 6.34  | 3.71 | 0.19      | -0.415 | 0.68    |
|      | Lt. 1PM | 49 | 6.15  | 3.50 |           |       |         |
| Buccal | Rt. 2PM | 50 | 2.78  | 2.78 | 0.15      | -0.617 | 0.54    |
|       | Lt. 2PM | 50 | 2.63  | 2.98 |           |       |         |
| Palatal | Rt. 2PM | 33 | 3.35  | 4.10 | 0.36      | -0.589 | 0.56    |
|       | Lt. 2PM | 33 | 2.99  | 2.87 |           |       |         |
| M. Buccal | Rt. 1M | 50 | 1.38  | 2.22 | -0.27     | -1.081 | 0.28    |
|       | Lt. 1M | 50 | 1.65  | 2.49 |           |       |         |
| D. Buccal | Rt. 1M | 50 | 1.45  | 1.70 | -0.15     | -0.281 | 0.78    |
|       | Lt. 1M | 50 | 1.59  | 2.08 |           |       |         |
| Palatal | Rt. 1M | 50 | 2.85  | 3.09 | 0.41      | -1.657 | 0.10    |
|       | Lt. 1M | 50 | 2.44  | 2.96 |           |       |         |
| M. Buccal | Rt. 2M | 50 | 0.75  | 1.41 | -0.14     | -0.356 | 0.72    |
|       | Lt. 2M | 50 | 0.89  | 1.32 |           |       |         |
| D. Buccal | Rt. 2M | 44 | 1.15  | 1.52 | -0.13     | -0.063 | 0.95    |
|       | Lt. 2M | 44 | 1.28  | 2.00 |           |       |         |
| Palatal | Rt. 2M | 50 | 1.98  | 2.79 | -0.16     | -0.383 | 0.70    |
|       | Lt. 2M | 50 | 2.14  | 2.30 |           |       |         |
Table 4: Comparison of mean thickness of respective cortical plate (in mm) of different maxillary posterior teeth root b/w right & left sides

| Root     | Tooth No. | N  | Mean | SD  | Mean Diff | Z     | P-Value |
|----------|-----------|----|------|-----|-----------|-------|---------|
| Buccal   | Rt. 1PM   | 49 | 0.89 | 0.53| -0.01     | -0.338| 0.74    |
|          | Lt. 1PM   | 48 | 0.90 | 0.60| -0.03     | -0.373| 0.71    |
| Palatal  | Rt. 1PM   | 48 | 0.94 | 0.67| 0.09      | -0.947| 0.34    |
|          | Lt. 1PM   | 48 | 0.97 | 0.59| -0.08     | -0.908| 0.92    |
| Buccal   | Rt. 2PM   | 48 | 1.25 | 0.87| 0.00      | 0.655 | 0.57    |
|          | Lt. 2PM   | 48 | 1.16 | 0.74| 0.14      | 1.663 | 0.10    |
| Palatal  | Rt. 2PM   | 39 | 1.02 | 0.75| 0.04      | 0.574 | 0.57    |
|          | Lt. 2PM   | 39 | 1.10 | 0.65| 0.00      | 0.574 | 0.57    |
| M. Buccal| Rt. 1M    | 50 | 0.88 | 0.66| 0.11      | -1.994| 0.06    |
|          | Lt. 1M    | 50 | 0.75 | 0.48| 0.14      | 1.389 | 0.17    |
| D. Buccal| Rt. 1M    | 50 | 1.08 | 0.64| 0.00      | -0.574| 0.57    |
|          | Lt. 1M    | 50 | 1.08 | 0.68| 0.00      | 0.574 | 0.57    |
| Palatal  | Rt. 1M    | 50 | 1.06 | 0.60| 0.11      | -1.994| 0.06    |
|          | Lt. 1M    | 50 | 0.94 | 0.54| 0.04      | 0.574 | 0.57    |
| M. Buccal| Rt. 2M    | 50 | 1.38 | 0.86| 0.14      | -1.389| 0.17    |
|          | Lt. 2M    | 50 | 1.24 | 0.83| 0.14      | -1.389| 0.17    |
| D. Buccal| Rt. 2M    | 44 | 1.38 | 0.66| 0.04      | 0.574 | 0.57    |
|          | Lt. 2M    | 44 | 1.39 | 0.81| 0.04      | 0.574 | 0.57    |
| Palatal  | Rt. 2M    | 50 | 1.19 | 0.73| 0.02      | 0.344 | 0.73    |
|          | Lt. 2M    | 50 | 1.21 | 0.89| 0.02      | 0.344 | 0.73    |

Table 5: Inter rater reliability assessment between rater-1 & rater-2

| Teeth  | Root    | Distance | Thickness |
|--------|---------|----------|-----------|
|        |         | ICC      | 95% CI    | P-Value  | ICC      | 95% CI    | P-Value  |
|        |         | Lower    | Upper     |          | Lower    | Upper     |          |
| Rt. 1PM| Buccal  | 0.76     | 0.36      | 0.94     | 0.002*   | 0.73      | 0.41      | 0.95     | 0.004*   |
|        | Palatal | 0.72     | 0.22      | 0.92     | 0.007*   | 0.69      | 0.18      | 0.91     | 0.009*   |
| Rt. 2PM| Buccal  | 0.79     | 0.37      | 0.95     | 0.002*   | 0.80      | 0.47      | 0.92     | 0.005*   |
|        | Palatal | 0.85     | 0.78      | 0.99     | 0.001*   | 0.72      | 0.60      | 0.93     | 0.008*   |
| Rt. 1M | M. Buccal| 0.81     | 0.70      | 0.98     | <0.001*  | 0.76      | 0.58      | 0.98     | 0.007*   |
|        | D. Buccal| 0.75     | 0.43      | 0.91     | 0.004*   | 0.74      | 0.59      | 0.91     | 0.002*   |
|        | Palatal  | 0.71     | 0.38      | 0.90     | 0.008*   | 0.70      | 0.43      | 0.97     | 0.009*   |
| Rt. 2M | M. Buccal| 0.80     | 0.47      | 0.92     | 0.005*   | 0.65      | 0.21      | 0.89     | 0.01*    |
|        | D. Buccal| 0.63     | 0.03      | 0.90     | 0.02*    | 0.73      | 0.59      | 0.95     | 0.003*   |
|        | Palatal  | 0.83     | 0.55      | 0.95     | <0.001*  | 0.68      | 0.19      | 0.90     | 0.02*    |
| Lt. 1PM| Buccal  | 0.77     | 0.41      | 0.94     | 0.001*   | 0.84      | 0.33      | 0.97     | <0.001*  |
|        | Palatal  | 0.72     | 0.26      | 0.92     | 0.005*   | 0.70      | 0.34      | 0.96     | 0.008*   |
| Lt. 2PM| Buccal  | 0.81     | 0.49      | 0.95     | <0.001*  | 0.79      | 0.46      | 0.98     | 0.001*   |
|        | Palatal  | 0.76     | 0.37      | 0.93     | 0.002*   | 0.88      | 0.57      | 0.99     | <0.001*  |
| Lt. 1M | M. Buccal| 0.88     | 0.69      | 0.97     | <0.001*  | 0.67      | 0.23      | 0.99     | 0.01*    |
|        | D. Buccal| 0.94     | 0.85      | 0.98     | <0.001*  | 0.63      | 0.39      | 0.95     | 0.03*    |
|        | Palatal  | 0.69     | 0.18      | 0.91     | 0.009*   | 0.72      | 0.34      | 0.96     | 0.002*   |
| Lt. 2M | M. Buccal| 0.89     | 0.70      | 0.97     | <0.001*  | 0.77      | 0.73      | 0.96     | 0.001*   |
|        | D. Buccal| 0.95     | 0.86      | 0.99     | <0.001*  | 0.72      | 0.55      | 0.96     | 0.001*   |
|        | Palatal  | 0.79     | 0.45      | 0.94     | <0.001*  | 0.79      | 0.48      | 0.93     | 0.001*   |

*Statistically Significant
Note: ICC - Intraclass Correlation Coefficient
ICC values <0.50 - Poor reliability
0.50 - 0.75 - Moderate reliability
0.75 - 0.90 - Good reliability
> 0.90 - Excellent reliability

Abbreviations: Lt.- Left, Rt.- Right, PM- Premolar, M- Molar, M. Buccal- Mesio Buccal, D. Buccal- Disto Buccal
Conclusion

The present study showed that palatal root of maxillary right 1st premolar was farthest from MSF and mesiobuccal root of maxillary right 2nd molar was nearest. Mean thickness of buccal cortical plate from distobuccal root of maxillary left 2nd molar was maximum & mesiobuccal root of maxillary left 1st molar was minimum. In comparing the mean distance between maxillary posterior teeth root apex to MSF & mean thickness of respective cortical plate of right and left side there was no significant difference. Adequate radiographic investigations are required before any surgical procedure in maxillary posterior teeth region. We recommend to use CBCT a 3-dimensional imaging modality when required. To concretely ascertain observations in our study, use of larger sample size is recommended and further studies can be conducted.

Conflict of Interest: None.

References
1. Von Arx T, Fodich I, Bornstein MM. Proximity of premolar roots to maxillary, sinus: A radiographic survey using cone-beam computed tomography. J Endod 2014;40:1541-8.
2. Shokri A, Lari S, Yousefi F, Hashemi L. Assessment of the relationship between the maxillary sinus floor and maxillary posterior teeth roots using cone beam computed tomography. J Contemp Dent Pract 2014;15:618-22.
3. Jung YH, Cho BH. Assessment of the relationship between the maxillary molars and adjacent structures using cone beam computed tomography. Imaging Sci Dent 2012;42:219-24.
4. Fuhrmann R, Bücker A, Diedrich P. Radiological assessment of artificial bone defects in the floor of the maxillary sinus. Dentomaxillofac Radiol 1997;26:112-6.
5. Misch CE. Contemporary implant dentistry. 2nd ed. St. Louis: CV Mosby Co, 1999:76-194.
6. Maloney PL, Doku HC. Maxillary sinusitis of odontogenic origin. J Can Dent Assoc 1968;34:591–603.
7. Georgiev T, Peev S, Arnautska H. Relationship between root apices of maxillary posterior teeth and the maxillary sinus floor in patients from the Varna region. Med Inform 2015;4:3009.
8. Fry RR, Patidar D, Goyal S, Malhotra A. Proximity of maxillary posterior teeth roots to maxillary sinus and adjacent structures using Denta scan. J Dent 2016;7:126-30.
9. Kilic C, Kamburoglu K, Yuksel SP, Ozen T. An assessment of the relationship between the maxillary sinus floor and the maxillary posterior teeth root tips using dental cone-beam computerized tomography. Eur J Dent 2010;4(4):462-7.

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