



## **The Relationship between the Roots of Maxillary Posterior Teeth and Maxillary Sinus Floor Using Cone Beam Computed Tomography: A Systematic Review**

**Vishesh Yadav and Puneeta Vohra**

*(Dept. of Oral Medicine and Radiology, Faculty of dental sciences, SGT University)*

**Corresponding author details:** Email id: [Vishesh\\_fds@sgtuniversity.org](mailto:Vishesh_fds@sgtuniversity.org)

### **ABSTRACT**

*The most recent focus of numerous researchers in the field of oral radiology has been on analysing the morphometric and anatomical variation of critical maxilla and mandibular structures using 3D CBCT scan. As one of the most significant structures in the maxillary region, the maxillary sinus proximity to the roots of the maxillary posterior teeth is critical for immediate implants, procedures for cyst/tumor, oroantral fistula, and other injuries to that area. Therefore, in this thorough systematic review, we are attempting to highlight the perspectives of many writers who planned and carried out CBCT investigations to assess the interaction between the roots of posterior maxillary teeth and the maxillary sinus floor. This research will eventually be used to develop artificial intelligence that can approximate important anatomical structures during various maxillofacial procedures.*

**KEYWORD:** CBCT, Maxillary sinus floor, Premolar, Molar

Received 21.10.2022

Revised 23.11.2022

Accepted 11.12.2022

### **INTRODUCTION**

Maxillary sinuses (MS) are significant anatomical elements that serve a variety of purposes, including acting as a resonance body for the voice, assisting with olfactory function, and regulating temperature and humidity.<sup>1</sup> They differ in morphology and anatomy, which includes size, form, and location on various sides of the same person as well as on distinct persons [1, 2]. Depending on a person's age, size, degree of pneumatization of the MS, and dental health, the inferior wall's topography changes where the posterior maxillary tooth root apices are located [3].

Due to their proximity to the region where maxillofacial operations and dental practices are conducted, MS are of interest to dentists [2]. The Maxillary Sinus Floor (MSF) extends its boundaries to the alveolar process between the roots of neighbouring teeth, resulting in tiny cortical zones of elevation and depression known as "extensions." with narrow cortical areas [4].

There are numerous clinical repercussions for posterior roots protruding into the maxillary sinus.<sup>3</sup> It is known that the tooth's apex has a larger impact on the antral tissue the closer it is to the MSF. Risks associated with this association can arise during endodontic or orthodontic treatments, as well as during some surgical procedures, such as tooth extraction and implant insertion [4].

Attempts to extract the roots or significant periapical surgery can result in oro-antral communication or cause entry of the root into the MS. In their routine dental practice, dental surgeons encounter several operations in various areas such as dental extractions, surgical implant procedures and augmentation surgeries for maxillary sinus floor in the hopes that osteogenesis will support and accommodate the future implant [5].

For the purpose of making the best decisions regarding treatment, surgery, and rehabilitation, it is crucial to have a thorough understanding of the anatomical landmarks [6]. Previous research revealed that the MS pneumatization volume is a metabolic process rather than a static state [7]. Their study came to the conclusion that whereas maxillary second molars are strongly associated to the MSF, maxillary first premolars are not. Some of these studies used their own classifications and some used classification from past studies [8].

The use of CBCT aids in diagnosis and gives doctors access to 3-dimensional data regarding the anatomical structures morphology and divergence. Axial, sagittal, and coronal slices are visible in the CBCT pictures, which minimize the superimposition of anatomical components. These benefits make it easier for the clinician to comprehend the tissue's whole anatomical structure.<sup>9,1</sup>

## DISCUSSION

In order to determine the morphometric analysis of various normal anatomical structures such as the nasal cavity, maxillary sinus, mandibular canal, etc. pertaining to the orofacial region, various studies have been designed and formulated since the introduction of CBCT imaging, which dates back to 1998 [14] which is the most recent in the field of orofacial radio diagnosis. A lot of researchers are interested in studying the proximity of the maxillary sinus, an important anatomical landmark in the maxillary region, in order to see how close the sinus is to the roots of the posterior maxillary teeth.

The first study, conducted in 2014 by Shokri A et al<sup>3</sup> screened 110 CBCT scans, they discovered that MSF which is positioned away from the apex of the tooth, is mostly seen in the 1<sup>st</sup> and 2<sup>nd</sup> PMs. This outcome was consistent with earlier research by Ok E<sup>10</sup> from 2014 and the most recent study by Razumova S et al [2] from 2019. However, Ok E et al<sup>10</sup> also noted that their research revealed a similar connection between MSF and the mesiobuccal and distobuccal roots of the first molar.

According to Shokri A et al [3] in 2014 and Razumova S et al [2] in 2019, the most commonly intruded teeth into the MSF were the first and second molars. But according to Ok E et al [10] in 2014 and Kaushik M et al<sup>12</sup> in 2020, the palatal root of the maxillary first molar has this kind of a relationship with MSF. Later in 2018, according to Gu Y et al [8] the palatal root of Maxillary 1st molar and MB root of the 2<sup>nd</sup> molar has such type of relationship with MSF in their investigation, which was consistent with the finding made by Zhan Xi et al [11] study in 2019. Although Yurdabakan ZZ et al [15] in year 2018 obtained inconsistent results, observed that the roots of 3rd molar showed such type of relation with the MSF, Goyal SN et al [13] in 2020 claimed that the entire the roots of 2nd molar showed such type of relation with the MSF.

Another relationship between MSF and roots involved the roots of maxillary posterior teeth contacting the MSF, according to Ok E et al<sup>10</sup> in 2014, this kind of relationship were most commonly seen in the MB roots of the 2<sup>nd</sup> molar. The first molar roots, however, exhibited this kind of relationship with MSF in their investigation, according to Goyal SN et al [13] in the year 2020.

o.	Author	Year of study	Results	
			Total CBCT Scans observed	Observations
1.	Shokri A et al [3]	2014	110 CBCT scans  1 <sup>st</sup> PM - 214 2 <sup>nd</sup> PM - 217 1 <sup>st</sup> M - 220 2 <sup>nd</sup> M - 220	The 1 <sup>st</sup> and 2 <sup>nd</sup> premolars frequently exhibit the most prevalent vertical relationship, in which the MSF is situated above the root tip. The apical projection above the maxillary sinus floor is the most prevalent horizontal relationship discovered, and it is frequently seen in the 1 <sup>st</sup> and 2 <sup>nd</sup> molars.
2.	Ok E et al [10]	2014	849 CBCT scans  1 <sup>st</sup> PM - 1340 2 <sup>nd</sup> PM - 1340 1 <sup>st</sup> M - 1243 2 <sup>nd</sup> M - 1243	The palatal roots of the 1 <sup>st</sup> molar teeth most usually displayed type 1. 2nd molar (mesiobuccal root) were the most frequently affected by type 2 (the roots met the sinus floor). The first and second premolar teeth, as well as the mesiobuccal and distobuccal roots of the first molar teeth, were the most commonly affected by type 3 (the roots extended below the sinus floor).
3.	Estrela C et al [6]	2016	202 CBCT scans  1 <sup>st</sup> PM - 300 2 <sup>nd</sup> PM - 300 1 <sup>st</sup> M - 300 2 <sup>nd</sup> M - 300	Type II was the most common vertical relationship identified, and type 2H was the most common horizontal relationship. (As stated by Kwak et al). First premolar buccal root and second molar mesiobuccal root cortical thicknesses ranged from 1.28 to 0.42 and 0.65 to 0.41 mm, respectively.
4.	Gu Y et al [7]	2018	1011 CBCT scans  1 <sup>st</sup> PM - 1745 2 <sup>nd</sup> PM - 1663 1 <sup>st</sup> M - 1331 2 <sup>nd</sup> M - 1360	1st molar(Palatal root) and 2 <sup>nd</sup> molar(MB) showed the highest type IS relationship, but the most prevalent relationship among all posterior roots was type OS (in which the root tip extends outside the MSF) (in which the root apex extending inside the MSF). The shortest distance from the MSF is present with mesiobuccal roots of 2 <sup>nd</sup> molar followed by 1 <sup>st</sup> molar (Palatal roots) and 2 <sup>nd</sup> molar (Distobuccal roots) are teeth that are closest to the floor of the maxillary sinus.

5.	El Khateeb SM et al [8]	2018	39 CBCT scans 1 <sup>st</sup> M - 58 2 <sup>nd</sup> M - 70 3 <sup>rd</sup> M - 32	The type 2 vertical relationship, where distance is <1 mm was most frequently observed. The type B horizontal relationship was the most prevalent.
6.	Zhang Xi et al [11]	2019	200 CBCT scans 1 <sup>st</sup> M - 400 2 <sup>nd</sup> M - 400	The smallest distance to the floor of maxillary sinus is present with mesiobuccal roots of the left and right second molars. Distobuccal roots of right second molar have the thinnest mucosa of the maxillary sinus.
7.	Razumova S et al [2]	2019	325 CBCT scans 1 <sup>st</sup> PM - 487 2 <sup>nd</sup> PM - 502 1 <sup>st</sup> M - 498 2 <sup>nd</sup> M - 454 3 <sup>rd</sup> M - 267	Type I vertical relationships between the first and second premolars were the most common. Type II was the most prevalent vertical relationship between the first and second molars. The 1 <sup>st</sup> molar(Palatal Root) is the furthest and 2 <sup>nd</sup> molar(mesiobuccal root) are closest from MSF.
8.	Peji J et al [9]	2020	212 CBCT scans 1 <sup>st</sup> M - 326 2 <sup>nd</sup> M - 326	MB root of 2 <sup>nd</sup> molar was closest to the MSF.
9.	Kaushik M et al [12]	2020	452 maxillary posterior teeth 1 <sup>st</sup> PM - 136 2 <sup>nd</sup> PM - 118 1 <sup>st</sup> M - 103 2 <sup>nd</sup> M - 95	Compared to the 1 <sup>st</sup> PM, the roots of the 2 <sup>nd</sup> PM were closer to MSF. The posterior roots most usually displayed a vertical connection of type OS (roots placed below the MSF). The palatal roots of the first molar were the most usually observed type IS (roots positioned inside the MSF) vertical relationship.
10.	Goyal SN et al [3]	2020	100 CBCT scans 1 <sup>st</sup> M - 185 2 <sup>nd</sup> M - 180	Frequently seen type II vertical relation was observed in 1 <sup>st</sup> molar and second molar had type III vertical relation.(In accordance with Kwak et al). The second molar's distobuccal roots had the greatest separation from the cortical plate, measuring 1.20 mm.
11.	K Shaul H et al [5]	2021	200 CBCT scans 1 <sup>st</sup> M - 400 2 <sup>nd</sup> M - 400	Type II was the most common vertical relationship identified, and type 2H was the most common horizontal relationship. (As stated by Kwak et al) The right second molar's distomolar root was closest to the maxillary sinus (range: 0.68 to 0.39 mm).

The MB root of the 2<sup>nd</sup> molar has the closest distance from the MSF, according to Estrela C et al [6] in 2016, Gu Y et al [7] in 2018, Zhang Xi et al [11] in 2019, Pei J et al<sup>9</sup> in 2020, and Razumova S et al [2] in 2019. This conclusion was reached in relation to a parameter where previous authors evaluated the shortest distance between MSF and roots of maxillary posterior teeth. The palatal roots of the first molar also displayed the smallest distance in regard to MSF, according to Estrela C et al [6].

The MB root of the 2<sup>nd</sup> molar, followed by the DB root of the 2<sup>nd</sup> molar and the palatal root of the 1<sup>st</sup> molar, had lowest distances to MSF, according to the findings investigated by Gu Y et al [7] in 2018. However, Kaushik M et al<sup>12</sup> in 2020 and K Shaul H et al [5] in 2021 proposed opposing findings. K Shaul H et al<sup>5</sup> observed that the DB root of the 2<sup>nd</sup> molar has the closest distance from MSF, while Kaushik M et al<sup>12</sup> in 2020 observed that the vertical distance of 2<sup>nd</sup> premolar from MSF was significantly less than that of the roots of the 1<sup>st</sup> premolar.

The findings of Estrela C et al [6] in 2016 and Razumova S et al<sup>2</sup> in 2019 were in conflict regarding the widest distance of roots of posterior maxillary teeth from the MSF. The former stated that the widest distance from MSF was found in the buccal root of the 1<sup>st</sup> premolar while latter observed that distance of the palatal root of first and second molar from MSF was found to be at maximum distance from MSF.

Numerous earlier studies have followed the classification system developed by Kwak *et al* [16] (2004), and using this system, they discovered that type II was the most frequently observed vertical relationship between roots of maxillary posterior teeth and MSF; this was confirmed by Estrela C *et al* in 2016 [6], Razumova S et al in 2019 [2], K Shaul H et al [5] in 2021. However, Zhan Xi et al [11] in 2019, Yurdabakan ZZ et al [15] in 2018 observed type 1 vertical relationship was present most commonly in their study.

To determine the horizontal relationship between posterior maxillary teeth roots and MSF, previous studies that used Kwak et al<sup>16</sup> classification, had consistent results and had type 2H relationship most commonly seen in the studies carried out by Estrela C *et al* [6] in 2016, K Shaul H *et al* [5] in 2021.

## CONCLUSION

The aforementioned systematic review offers a clear understanding of the various studies that were carried out to check the connection between maxillary roots of posterior teeth and the maxillary sinus floor using 3D imaging i.e. CBCT. Through this, we can show that there are many differences between the findings of different researchers, which can be attributed to anatomical variations and varied geographic distribution. As a result, it is crucial to understand the thorough systematic examination of prior literature in order to develop a comprehensive and detailed future research on a related area of interest.

## Conflict of interest

There are no conflicts of interest, according to the authors.

## REFERENCE:

1. Chan PS, Sung CE, Tsai YW, Yuh DY, Chen YW, Wung HY et al. (2020). The relationship between the roots of posterior maxillary teeth and adjacent maxillary sinus floor was associated with maxillary sinus dimension. *Journal of Medical Sciences*. 40:207-14.
2. Razumova S, Brago A, Howijeh A, Manvelyan A, Barakat H, Baykulova M. (2019). Evaluation of the relationship between the maxillary sinus floor and the root apices of the maxillary posterior teeth using cone-beam computed tomographic scanning. *J Conserv Dent*. 22:139-43.
3. Shokri A, Lari S, Yousefi F, Hashemi L. (2014). Assessment of the Relationship between the Maxillary Sinus Floor and Maxillary Posterior Teeth Roots using Cone Beam Computed Tomography. *The Journal of Contemporary Dental Practice*. 15(5):618-22.
4. Roque-Torres GD, Ramirez-Sotelo LR, Vaz SL, Bóscolo SM, Bóscolo FN. (2016). Association between maxillary sinus pathologies and healthy teeth. *Brazilian journal of otorhinolaryngology*. 82(1):33-8.
5. K Shaul H, Elsantawy AE, Alasmari D. (2021). Radiographic evaluation of the anatomical relationship of maxillary sinus floor with maxillary posterior teeth apices in the population of Al-Qassim, Saudi Arabia, using cone beam computed tomography. *Saudi Dental Journal*. 33:769-74.
6. Estrela C, Nunes CA, Guedes OA, Alencar AH, Estrela CR, Silva RG et al. (2016). Study of anatomical relationship between posterior teeth and maxillary sinus floor in a subpopulation of the Brazilian central region using cone-beam computed tomography-part 2. *Brazilian dental journal*. 27(1):9-15.
7. Gu Y, Sun C, Wu D, Zhu Q, Leng D, Zhou Y. (2018). Evaluation of the relationship between maxillary posterior teeth and the maxillary sinus floor using cone-beam computed tomography. *BMC Oral Health*. 18(164):1-7.
8. El Khateeb SM, Zain-Alabdeen EH. (2018). Intraobserver and Interobserver Reliability Assessment of the Proximity of Maxillary Molars to the Maxillary Sinus Using Cone- beam CT. *Egyptian Dental Journal*. 64(3):2205-15.
9. Pei J, Liu J, Chen Y, Liu Y, Liao X, Pan J. (2020). Relationship between maxillary posterior molar roots and the maxillary sinus floor: cone-beam computed tomography analysis of a western Chinese population. *Journal of International Medical Research*. 48(6):1-17.
10. Ok E, Güngör E, Çolak M, Altunsoy M, Nur BG, Ağlarci OS. (2014). Evaluation of the relationship between the maxillary posterior teeth and the sinus floor using cone-beam computed tomography. *Surgical and Radiologic Anatomy*. 36:907-14.
11. Zhang Xi, Li Y, Zhang Y, Hu F, Xu B, Shi X, Song L. (2019). Investigating the anatomical relationship between the maxillary molars and the sinus floor in a Chinese population using cone-beam computed tomography. *BMC Oral Health*. 19(282):1-8.
12. Kaushik M, Kaushik P, Mehra N, Sharma R, Soujanya E, Kumar U. (2020). Anatomical relationship between roots of maxillary posterior teeth and maxillary sinus using cone- beam computed tomography. *Endodontology*. 32(3):124-9.
13. Goyal SN, Karjodkar FR, Sansare K, Saalim M, Sharma S. (2020). Proximity of the roots of maxillary posterior teeth to the floor of maxillary sinus and cortical plate: A cone beam computed tomography assessment. *Indian J Dent Res*. 1:911-5.
14. Fathima S, Manikandan. (2020). CBCT in dentistry- An overview. *European Journal of molecular & clinical Medicine*. 7(5):1403-08.
15. Yurdabakan ZZ, Okumus O, Pekiner FN. (2018). Evaluation of the maxillary third molars and maxillary sinus using Cone beam computed tomography. *Niger J Clin Pract*. 21:1050-8.
16. Kwak HH, Park HD, Yoon HR, Kang MK, Koh KS, Kim HJ. (2004). Topographic anatomy of the inferior wall of the maxillary sinus in Koreans. *International journal of oral and maxillofacial surgery*. 33:382-8.

## CITATION OF THIS ARTICLE

Vishesh Yadav and Puneeta Vohra : The Relationship Between The Roots Of Maxillary Posterior Teeth And Maxillary Sinus Floor Using Cone Beam Computed Tomography: A Systematic Review. *Bull. Env.Pharmacol. Life Sci., Spl Issue* [5]: 2022: 85-88.