Assessment of the relationship between the maxillary sinus floor and roots of maxillary posterior teeth - a MSCT study

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Abstract:To assess the relationship between the maxillary sinus floor (MSF) and the maxillary posterior roots using Multi-slice computed tomography (MSCT) in Indian population. Materials and Methods: MSCT images of about 604 maxillary sinuses from 302 patients were studied. The relationship of 2416 teeth and 5926 root tips consisting of first premolar, second premolar, first and second molar to the maxillary sinus were examined. Image analysis was done separately by an endodontist, a postgraduate student and a radiologist trained in MSCT. The observers has to assess the vertical relationship between the MSF and the roots of molar and premolar teeth which were noted as "g" for gap between root tip and MSF; "t" for root tip touching the MSF; "p" for root projecting into the sinus and the length of projection into the sinus was measured in millimeters. Data were recorded and statistical analysis was done.

Keywords : - Maxillary sinus floor, posterior teeth, Multi-slice computed tomography.

1. INTRODUCTION:

The accurate assessment of the interrelationship of the maxillary sinus with the posterior teeth in the maxillary region is imperative for the success of surgical and non-surgical endodontic treatment, placement of dental implants or extraction.The maxillary posterior teeth can be alienated from the maxillary sinus floor (MSF) by cancellous bone, cortical bone lining of sinus or just Schneiderian membrane and in about 50% of the population, maxillary sinus extends into the alveolar process of the maxilla[1]. Apical periodontitis in maxillary posterior teeth can also elicit an inflammatory response in the maxillary sinus causing mucositis, sinusitis, periostitis or oroantral syndromes[2-5]. On the other hand, maxillary sinusitis also may mimic pain of dental origin, especially of the maxillary posterior teeth. Care should be taken during differential diagnosis of pain in the maxillary molars and premolars and also during endodontic procedures to prevent extrusion of microbes and debris into the sinus.Ethnic anatomical variation of the para-nasal sinuses has been reported in the literature[6-8]. Therefore, an exact assessment of the relationship between the maxillary sinus floor (MSF) and roots of maxillary posterior teeth of various populations is essential from an endodontic perspective.

The affiliation between maxillary sinus and roots of maxillary tooth can be assessed using various imaging techniques. Multi-slice computed tomography [MSCT] gives 3 dimensional images of anatomical structures that are unobscured by overlying structures in any plane. Also, the image quality of MSCT was judged to be equivalent to that of CBCT for visualizing relationship of teeth and bone[9-11]. To the best of our knowledge, there is no study in the literature that evaluate the relationship of maxillary posterior teeth and maxillary sinus floor in Indian population. Thus, the aim of this study was to substantiate the relationship between the MSF and the maxillary posterior roots in MSCT images in Indian population.

2. MATERIALS AND METHODS:

Data collection:

In this retrospective study, database of patients scanned with MSCT were obtained from a speciality scan centre at Chennai. The images were made with the GE bright speed and analysed

using the software ADW 4.4. The voxel size was 0.3mm spiral CT system using the 120 kVp and 200mA. The inclusion criteria were patients in the age group of 21 – 70 years of age with full set of maxillary teeth and fully formed apexes. The patients included were free from any systemic disease. Images showing missing maxillary posterior teeth, having maxillary implants, cystic/ tumorous lesions or patients scanned for traumatic injury were excluded from the study. A total of 604 maxillary sinuses from 302 patients (133 females and 169 males) who met our inclusion criteria were studied. The relationship of 2416 teeth and 5926 root tips consisting of first premolar, second premolar, first and second molar to maxillary sinus was examined.

Data analysis:

All images were studied separately by an experienced endodontist, a postgraduate student and a radiologist trained in MSCT. In case of disagreement between the observers, it was discussed with another radiologist until they reach a consensus. The observers has to assess the vertical relationship between the MSF and the roots of molar and premolar teeth which were noted as "g" for gap between root tip and MSF, "t" for root tip touching the MSFwhere there was no discernible difference between root tip and MSF and "p" for root projecting into the sinus respectively and the length of projection into the sinus was measured in millimeters.

The mesiobuccal, distobuccal and palatal roots of the first and second molar were individually analyzed and tabulated for their "g", "t" and "p" values. Regarding premolars, the buccal and palatal of first premolar were noted separately and for second premolar though there was considerable number of fused roots it was also noted as buccal and lingual roots.All the measurements were entered and analyzed using SPSS package version 20. Differences were considered as statistically significant when P<0.05.

3. RESULTS

Frequency analysis

Premolar:

Table I& IIshows that majority of the roots of the first and second premolar were located below the border of the maxillary sinus floor. Results showed second premolar (5.1%) to be more closely associated with MSF than first premolar (1.3%) and it's more prevalent in males.Both buccal and palatal roots of first premolars, type "g" occurred more frequently [70.2%, 70.2%] than type "t" [28.65%, 28.5%] and type "p"[1.15%, 1.3%]. Similarly, for both buccal and palatal roots of second premolars, type "g" occurred more frequently [67.35%, 68%] than type "t" [27.65%, 26.85%] and type "p"[4.95%, 5.1%]. No significant difference was found between the right/left side. Buccal and palatal roots of second premolars and palatal roots of first premolar, type "g", "t", "p" was more prevalent in males than in females. For buccal root of first premolar, type "g", "t" was more prevalent in males and type "p" was more prevalent in females.Table III shows the association between age and relationship of premolar roots to MSF. Type "g" was found to be more prevalent in patients with third decade.

Molar:

Table IV & V shows that the first molar teeth, type "t" occurred more frequently in palatal root [55.3%], type "g" and type "p" in MB roots [42.5%] and [13.5%]. In second molar teeth, type "t" occurred more frequently in DB roots [55.55%], type "g" in palatal root [34.45%] and type "p" in MB roots [14.55%].

When analyzing the frequency of roots projecting into the maxillary sinus, MB root of second molar [14.55%] and first molars [13.6%] projects more frequently into the sinus floor followed by palatal root and distobuccal root.

Type "p" [projection into the sinus] was more commonly seen in females in case of first molars and males in second molars; type "g" and type "t" in malesfor MB roots.When Palatal roots were evaluated, for first and second molars type "p" and type "t" was predominantly seen in males, type "g" in females.

For DB roots both first and second molars,type "g" is predominantly seen in females, type "t" in males.Type "p" is seenmost frequently in males in case of first molars and females in second molars.

When first and second molars were evaluated by age, it was seen that as age increases, type "g" increases and type "p" and type "t" decreases i.e the distance between the MSF and roots of maxillary posterior teeth increases and the closer association with MSF was found in patients with third decade [Table VI].

4. DISCUSSION:

There are numerous radiographic techniques that are available to diagnose the maxillary sinus and to establish its relationship to the maxillary posterior teeth. Among them CBCT proves to be a reliable technique to assess the relationship between the MSF and the maxillary posterior teeth. However, previous studies have also shown that MSCT can be considered as an equivalent tool to CBCT[9-11].

When type "g", "t" and "p" are considered, type "t" should be as significant as type "p" in endodontics as extrusion, overfilling or over-instrumentation can be equally dangerous in both t" and "p".

Buccal and palatal roots of second premolars are more closely associated with MSF when compared to the first premolars irrespective of the root, side or gender. However projection of root into sinus is age dependent (P = 0.000). The roots of maxillary premolar have predominantly type "g" relationship with the MSF i.e. more than 70 % of first premolars and 68% of second premolars are of type "g" and 28% and 27% of first and second premolars respectively are of type "t". In the present study,1.15% and 1.3% of buccal and palatal roots of first premolars, 4.95%, 5.1% of buccal and palatal roots of second premolars respectively project into the MSF. The result is similar to study by Von Arx et al. who showed 0.7%−2.3% for buccal apices, 7.1-7.8% for palatal apices[12].

When buccal and palatal roots of molars were considered, type "p" and type "g" occurred most frequently in buccal roots and type "t" occurred most frequently in palatal roots of first molars. In second molar teeth, type "p" and type "t" occurred most frequently in buccal roots and type "g" occurred most frequently in palatal roots of second molars. Type "t" is the most frequent vertical relationship between all the three roots of maxillary first and second molar teeth and MSF. The results of the present study shows that buccal roots of molars projects more into the MSF than the palatal roots.For palatal roots, predominance of type "p" is in males for both first and second molars.

For the first molar teeth, there was statistically significant association between the age and length of mesiobuccal, distobuccal roots of molars projecting into the sinus and no statistically significant association between the age and length of palatal root. In the present study, 13.6%, 11.25% and 11.7% of MB,DB, P roots of first molars and 14.%, 12.25% and 12.75% of MB,DB, P roots of second molars respectively project into the MSF.In second molars, more than two thirds of buccal and palatal roottips are in contact with the sinus floor, whereas in first molars, 56% of MB and 63-65% of DB and Palatal roots are in contact with the sinus floor.

The first and the second molar had no statistically significant difference in relationship to MSF and there is no difference among the different roots either. This is in contrast to the study of Jung and Cho, where buccal roots of molars were more closely associated with MSF[13]. Other studies have also shown a contrast that the buccal roots of second molar are closely related to the floor of the maxillary sinus[14-17].

In our present study, MB roots of first and second molars are projected more into the MSF than the palatal roots which is in contrast to the study of Kwak et al, where palatal roots projected more into the sinus in maxillary first molars and no palatal root protrusion in the second molar. However buccal roots was observed to project into the sinus in 14.2%[17].

According to the study on Romanian population by Didilescu et al, the palatal root of maxillary first molar was projecting into the sinus more frequently which was again different in our study where there was no difference among roots of a maxillary molar[18]. The result of the present study is in accordance with study of Eberhardt et al in American population , Jung et al in Korean population, OtavioPagin et al of Brazilian population and Xiao-mei Tian et al in Chinese population, who reported highest frequency of penetration into MSF in MB roots of maxillary second molars, but the result is in contrast to the study of Kwak et al in Korean population, where DB root of maxillary second molar is closest to MSF[13,15,19,20,17].

The results of the present study shows that maxillary second molar projects more into the MSF [14.55%] followed by maxillary first molar [13.6%], second premolar [5.1%] and first premolar [1.3%] which is in accordance with study of Sharan and Madjar in Israel population where second molar was protruding more into the sinus compared to first molar (approx. 29% and 21%), second premolar (approx. 8%)[21]. The result of the present study indicated that the frequency of roots projecting into the sinus was predominantly seen in subjects of third decade. Therefore, in Indian population, root canal treatment should be done with extreme care in patients of third decade, as there are more chances of sinus infection if material extrudes into sinus in both buccal and palatal roots of first and second molars.

5. CONCLUSION:

The following conclusions can be made from this study.

a. Second molar in general was more closely associated with MSF than first molar.
b. There was no statistically significant difference between males and females with respect to association between MSF and posterior teeth.
c. The closer association between MSF and maxillary posterior teeth was predominantly found in 30-40 age group among the subjects studied.
d. In order of closer association with MSF, MB of Second molar > MB of first molar > palatal root of second molar > distobuccal root of second molar > palatal root of first molar > distobuccal root of first molar.

Therefore, effective endodontic management of maxillary posterior teeth requires meticulous preoperative treatment planning and thorough knowledge of anatomical relationship of maxillary sinus floor to the root tips of maxillary molar so as to prevent chances of infection in to the sinus.

CONFLICT OF INTEREST: Nil

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