Research Letter

Stature Estimating the Location of Maxillary Sinus and Mandibular Canal

Estimation of variations in the location of the maxillary sinus and the mandibular canal depending on the stature was done in cross sectional images. Alveolar bone height was determined in individuals of different height groups and a comparative study of location of the maxillary sinus and the mandibular canal in the jaws was done using linear tomographic program. Assessment of location of vital anatomic structures such as maxillary sinus and mandibular canal in the jaws are required while enterprising quality dental care during simple extractions, impactions, surgeries of the involved, and dental implants. The most common stature estimates are long bones based upon the principle that the various long bones correlate positively with stature. Relating the association of the stature with the location of maxillary sinus and mandibular canal helps in various dental procedures and in careful selection of the length of the implant. The results revealed the mean distance of the position of maxillary sinus and the mandibular canal in relation to the alveolar crest in the different height groups. A significant inference of this study reveals that height wise there was a very high statistical significance in the location of the mandibular canal.

The aim of the present study is to assess the location of the maxillary sinus and mandibular canal in different height groups attending the outpatient department. To compare the location of these anatomic structures among the different height groups. A total of 77 healthy dentulous patients ranging between 140 and 180 cm height, categorized into four different height groups were chosen from the outpatient dental clinic. The four groups were Group A (28) belonging to 140–150 cm, Group B (37) of 151–160 cm, Group C (18) of 161–170 cm, and Group D (7) of 171–180 cm. Patients below 15 and above 45 years or suffering from any form of infection in the jaws and systemic disease were excluded. Patients included had intact posterior teeth from premolars to molars and were devoid of any developmental defects.

After obtaining ethical committee clearance a linear tomographic radiograph was taken on patient in the standardized position with proper radiation protective measures. The film was then developed in the automatic processor. The distance between the buccal alveolar crest and lingual alveolar crest up to the anatomical structures (the lowermost position of maxillary sinus and the superior position of mandibular canal) in maxilla and mandible was measured via Adobe Photoshop 7. Then the average of the distance between the buccal and lingual alveolar crests up to the anatomical structures was calculated and the derivatives were calibrated with the 1 cm scale measurements in the same radiograph. The magnification factor for the tomographic radiograph in promax planmeca, that is, 1.5 was also considered and calculated before arriving at the final values. Statistical test analysis of variance (ANOVA) was used to compare the four groups and Tukey honestly significant difference (HSD) was used for multiple comparisons between the groups.

The descriptive values of the mean distance from the lower most border of the maxillary sinus up to the alveolar crest of maxillary first and second premolars and molars in all the four groups did not reveal any statistical significance [Table 1]. Consequently multiple comparison of the mean distance of the lowest border of the maxillary sinus up to the alveolar crest of the maxillary first and second premolars and molars between individual groups also did not show any statistical significance [Table 2]. The mean distance of the superior border of the mandibular canal up to the alveolar crest of

| Table 1: Mean distance between the maxillary anatomical structures at posterior teeth in different height groups |
|---------------------------------|----------|----------|----------|--------|--------|--------|
| Descriptive variable            | Height   | N        | Mean     | S.D    | F      | P      |
| Maxillary 1<sup>st</sup> premolar | 140-150  | 28       | 11.8325  | 2.47331| 0.704  | 0.552  |
|                                 | 151-160  | 37       | 11.9866  | 2.96910|        |        |
|                                 | 161-170  | 18       | 11.6223  | 2.55781|        |        |
|                                 | 171-180  | 7        | 10.4244  | 1.33485|        |        |
| Maxillary 2<sup>nd</sup> premolar| 140-150  | 28       | 11.4593  | 1.97149| 1.154  | 0.332  |
|                                 | 151-160  | 37       | 11.1390  | 2.21630|        |        |
|                                 | 161-170  | 18       | 10.7984  | 2.33375|        |        |
|                                 | 171-180  | 7        | 9.8905   | 1.30509|        |        |
| Maxillary 1<sup>st</sup> molar  | 140-150  | 28       | 11.1601  | 2.13423| 1.479  | 0.226  |
|                                 | 151-160  | 37       | 10.9440  | 2.60781|        |        |
|                                 | 161-170  | 18       | 10.5086  | 2.30085|        |        |
|                                 | 171-180  | 7        | 9.1833   | 1.36831|        |        |
| Maxillary 2<sup>nd</sup> molar  | 140-150  | 28       | 10.8436  | 2.31305| 2.040  | 0.114  |
|                                 | 151-160  | 37       | 10.0007  | 2.45577|        |        |
|                                 | 161-170  | 18       | 9.2882   | 1.89696|        |        |
|                                 | 171-180  | 7        | 9.2738   | 2.31726|        |        |
the mandibular first and second premolars and molars in the individual height groups is shown in Table 3. Mean distance was receding as it moved posteriorly from the mandibular first premolar to second premolar, first molar, and second molar in all the groups. The mean distance was very highly significant in the premolars, whereas in the first molar it was highly significant and in the second molar it was significant.

Table 4 shows multiple comparison of the mean distance of the superior border of the mandibular canal up to the alveolar crest. The mean distance was very highly significant between the group A and group C in case of first mandibular premolar and molar. Highly significant mean distance difference was seen between the same group A and group C in case of second premolars and molars. There was significant mean distance difference between group B and group C in case of mandibular first and second premolar.

The mean distance from the lower border of the maxillary sinus and the superior border of the mandibular canal up to the alveolar crest in 77 patients with different statures was acquired in the Indian population using linear tomographic program of the cross sectional imaging, which is easily accessible, economical, and relatively accurate. Assessment and correlation of the alveolar vertical height and location of vital anatomic structures with the stature benefits the dentist in clinical practice. Preoperative bone height was appraised from the top of the alveolar crest to the superior border of the mandibular canal on a standard panoramic radiograph and it was stated as a safe preoperative evaluation protocol for routine posterior mandibular implant placement.[5]

Cross sectional imaging modality appears to be a very accurate tool in the assessment of the location of vital anatomic structures such as maxillary sinus and mandibular canal in the jaws, since it helps in evaluation of location of the vital anatomic structures, buccolingual width of jaws, bone thickness, and bone density. Conventional tomography is the most practical solution in the routine practice of dentistry as it is easily accessible, less complex, and very economical. American Academy of Oral and Maxillofacial Radiology (AAOMR) in its position paper edited by Tyndall and Brooks have recommended that some form of cross sectional imaging be used for implant cases and that conventional crossectional tomography is the method of choice for gaining this information for most patients receiving implants.[5]

Japanese study in panoramic radiographs showed that the sinus floor to the alveolar crest was $6.9 \pm 4.75$ mm on the right side and was $6.6 \pm 4.78$ mm on the left side in edentulous jaws.[4] Our study which was carried out in

| Table 2: Multiple comparison of individual height group for the mean distance difference in maxilla |
|-----------------------------------------------|
| Multiple comparisons (Tukey HSD)               |
| Dependent variable  | (I)HT1 | (J)HT1 | Mean difference (I-J) | P     |
| Maxillary 1st premolar | 140-150 | 151-160 | -0.1541 | 0.996 |
|                | 161-170 | 171-180 | 0.1819 | 0.976 |
|                | 140-150 | 151-160 | 1.4081 | 0.593 |
|                | 161-170 | 171-180 | 0.3643 | 0.964 |
|                | 140-150 | 151-160 | 1.5621 | 0.485 |
|                | 161-170 | 171-180 | 1.1979 | 0.741 |
|                | 140-150 | 151-160 | 0.3203 | 0.930 |
|                | 161-170 | 171-180 | 0.6609 | 0.730 |
| Maxillary 2nd premolar | 140-150 | 151-160 | 1.5688 | 0.302 |
|                | 161-170 | 171-180 | 0.3406 | 0.943 |
|                | 140-150 | 151-160 | 1.2485 | 0.483 |
|                | 161-170 | 171-180 | 0.9079 | 0.770 |
|                | 140-150 | 151-160 | 0.2162 | 0.983 |
|                | 161-170 | 171-180 | 0.6515 | 0.792 |
|                | 140-150 | 151-160 | 1.9768 | 0.195 |
|                | 161-170 | 171-180 | 0.4353 | 0.916 |
|                | 140-150 | 151-160 | 1.7606 | 0.267 |
|                | 161-170 | 171-180 | 1.3253 | 0.582 |
|                | 140-150 | 151-160 | 0.8430 | 0.464 |
|                | 161-170 | 171-180 | 1.5554 | 0.121 |
|                | 140-150 | 151-160 | 1.5698 | 0.376 |
|                | 161-170 | 171-180 | 0.7125 | 0.704 |
|                | 140-150 | 151-160 | 0.2769 | 0.869 |
|                | 161-170 | 171-180 | 0.0144 | 1.000 |

| Table 3: Mean distance between the mandibular anatomical structures at posterior teeth in different height groups |
|-----------------------------------------------|
| Descriptives | Height | N | Mean | S.D | F | P  |
| Mandibular 1st premolar | 140-150 | 28 | 16.9366 | 2.79103 | 5.832 | 0.001 vhs |
| Mandibular 2nd premolar | 140-150 | 28 | 16.3067 | 2.60457 | 7.262 | 0.001 vhs |
| Mandibular 1st molar | 140-150 | 28 | 15.5485 | 2.55204 | 5.334 | 0.002 hs |
| Mandibular 2nd molar | 140-150 | 28 | 14.8804 | 2.47613 | 3.975 | 0.011 significant |
different height groups showed that the location of the maxillary sinus from alveolar crest varied a lot and did not show any statistical significance. This may be due to a reduced sample size which may not be sufficient to possess a precise value and furthermore the degree of pneumatization differs from individual to individual and from side to side. Therefore the mean distance will differ among individuals and also from right to left maxillary sinus in the same individual.

The study directed in Japanese population revealed that the distance from the alveolar crest of the mandibular molar region to the superior wall of the mandibular canal was 9.1 ± 5.54 mm on the right side and was 9.9 ± 5.05 mm on the left side of the edentulous jaws. Similarly, the evaluation of mandibular canal from the alveolar crest in the Berne population showed that the average measured bone height from the mandibular canal to the alveolar crest in the panoramic radiograph was 13.9 ± 2.66 mm and the average bone height in linear tomography was 14.87 ± 3.3 mm.

Study in Turkish population showed that in mandible the vertical height showed high statistical significance

The statistical significance may also be due to the steady development of the growth centers and the musculoskeletal system. Additionally, the size and shape of the mandible is also influenced by variable lifestyles, chewing habits, ethnicity, and stature. Literature review shows that most of the study is done on edentulous jaws for implant design. With reference to implant placement, it is significant to determine the amount of bone resorption taking place in an extraction wound. There will be a reduction of 0.8 mm in apicocoronal ridge height at 3 months and greater apicocoronal changes at multiple adjacent extraction sites which is more in molar areas than in the premolar sites and in the mandible relatively with maxilla. Apicocoronal crestal bone height reductions of 0.7–1.5 mm occurs after 4–6 months, and 2–4.5 mm over a 6–12 month postextraction period along with horizontal changes.

Thus subtracting resorption height from the mean distance in the mandible of different stature groups derived from our study population in south India, this appropriate implant length can be determined. This study was on 77 healthy dentulous patients of a local area and therefore represents only for this population. For a more accurate assessment, this study should be further conducted for a larger sample residing in various parts of the world.

Wide variations in jaw anatomy are encountered in different races and different populations and therefore the location of these vital structures vary among the individuals within considerably normal limits. Even within a given population, depending upon the patient’s stature, age, sex, the location of these anatomically challenging vital structures may differ. Therefore prior to implant placement the location of these vital anatomic structures should normally be assessed by vigilant clinical examination and radiographic analysis.

Inferences drawn from this study were that the mean distance between the alveolar crest and the maxillary

| Table 4: Multiple comparison of individual height group for the mean distance difference in mandible |
|----------------------------------|---|---|---|
| Multiple comparisons (Tukey HSD) | (I)HT1 | (J)HT1 | Mean difference (I–J) | P |
| Mandibular 1st premolar | 140-150 | 151-160 | −1.1993 | 0.001 vhs | 0.303 |
| 151-160 | 161-170 | −3.2409 | 0.980 |
| 171-180 | −2.7720 | 0.084 |
| 151-160 | 161-170 | −2.0416 | 0.05 sig |
| 171-180 | −1.5728 | 0.504 |
| 161-170 | 171-180 | 0.4689 | 0.980 |
| 140-150 | 151-160 | −0.9764 | 0.458 |
| 161-170 | −2.9525 | 0.002 hs |
| 171-180 | −4.0325 | 0.003 hs |
| 151-160 | 161-170 | −1.9761 | 0.05 sig |
| 171-180 | −3.0561 | 0.031 sig |
| 161-170 | 171-180 | −1.0800 | 0.796 |
| 140-150 | 151-160 | −1.2131 | 0.281 |
| 161-170 | −3.1337 | 0.001 vhs |
| 171-180 | −2.3621 | 0.169 |
| 151-160 | 161-170 | −1.9206 | 0.070 |
| 171-180 | −1.1490 | 0.729 |
| 161-170 | 171-180 | 0.7716 | 0.918 |
| 140-150 | 151-160 | −1.1345 | 0.563 |
| 161-170 | −2.7526 | 0.008 hs |
| 171-180 | −2.2240 | 0.234 |
| 151-160 | 161-170 | −1.6181 | 0.183 |
| 171-180 | −1.0895 | 0.775 |
| 161-170 | 171-180 | 0.5286 | 0.973 |
sinus and the mandibular canal was decreasing as it was moving posterior. A very high statistical significance was observed in the mean distance of the mandibular first premolar region with a $P$ value of 0.001 and a high significance was seen with respect to mandibular second premolar, first molar, and second molar. Thus our study suggests there is a positive correlation between the stature of an individual and the mean distance of the alveolar crest till superior most location of the mandibular canal. This study is confined to a small population in India and further work up of larger population in various study samples in other countries also is necessary to possess an accurate assessment value.

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