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Original Article

Submandibular Gland Fossa Assessment with Cone Beam Computed Tomography

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Abstract

Introduction: Cone beam computed tomography (CBCT) is often used in pre-implant planning where it helps assessing the amount of bone availability and its relationship from its surrounding structures. In certain vital areas such as inferior alveolar nerve canal and submandibular gland fossa, it is important to know the dimensions of the bone to avoid post-operative complications. The aim of the study was to evaluate the deepest area or the concavity depth submandibular fossa on CBCT and also to measure/determine the distance from the mental foramen to the deepest concavity depth and the height of alveolar crest from the deepest concavity depth.

Materials and Methods: Retrospective studies of CBCT images were obtained on a KODAK 9000 three-dimensional (3D) extraoral imaging systems using CS 3D imaging software. The site of the submandibular gland fossa was identified, and measurements were done to evaluate the depth of the fossa, its distance from the alveolar crest and from the mental foramen.

Results: The lingual concavity depth over a range up to a maximum value of 3.70 mm and the minimum depth up to 0.5 mm. Analysis of variance compared the mean values and standard deviation for mandibular measurements between male and female. The sexes did not differ significantly. Independent sample *t*-test did not demonstrate any difference among the age group,$^{\#}P > 0.05$.

Conclusion: CBCT is an important tool for assessing the mandibular region and planning for safe implant placement in the posterior mandible.

Key words: Cone beam computed tomography, Implant planning, Submandibular gland fossa

INTRODUCTION

Cone beam computed tomography (CBCT) is the most advanced imaging modality with wide applications in implant dentistry[1].

the submandibular gland (SMG), the second largest gland, is about one half the weight of the parotid and is found inferior to the mandible, between the anterior and posterior bellies of the digastric muscle. In the mandibular posterior region, prior to implant placement it is mandatory to know the depth of submandibular gland fossa i.e., deeper fossa,[2] if undiagnosed prior to the implant placement could lead to the perforation of lingual plate, so pre surgical imaging provides valuable information in the assessment of potential implant fixture sites. One of the major cause for failure of dental implant in mandibular posterior region is the perforation into the submandibular fossa. Which can be serious complication in mandibular symphysis[2]. The submandibular gland is lodged in this fossa shows submental and sublingual arteries may course intimately to the lingual cortical plate from the floor of the mouth.[2] Hence the aim of our study is for the assessment of submandibular gland fossa with cone beam computed tomography.

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MATERIALS AND METHODS

The study was conducted at the Department of Oral Medicine and Radiology, DY Patil University School of

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Dentistry, Navi Mumbai, Maharashtra, India, between June 2016 and October 2016. A 100 scans were browsed (single volume, unilateral side, and dentulous dentition) and fulfilled the inclusion criteria. Out of them, 56 (56.00%) were male and 44 (44.00%) were female [Table 1].

Images of 100 dentulous mandibular posterior regions were studied. The CBCT images were obtained with a KODAK 9000 three-dimensional (3D) extraoral imaging systems (manufacturer/distributor-Kodak dental systems, Carestream Health, Rochester, NY) and HP Windows desktop (Compaq le1911). The resultant image is showed in Figure 1. The software used was CS 3D imaging software 3.3.11. Operating parameters were set at 8.0 mA and 88 KV and exposure time of 10.8 s for single volume and 10 mA, 70 KV, 32.40 s for stitched volume. Voxel size was 76 μ for single volume and was measured on 76 μm slice thickness.

For single volumes, focused field of view was used around 500 mm × 38 mm. The 3D volume stitching program combines up to 3 focused field volumes, automatically constructing an extended field image of around 85 mm × 66 mm × 37 mm.

- The tangent line is drawn from prominent superior and inferior point's lingual concavity corresponding with the submandibular fossa on para planar slices resultant value was (7.3 mm) shown in Figures 2-4.

Table 1: Distribution of participants according to gender

Gender	Frequency
Male	56 (56.0)
Female	44 (44.0)
Total	100 (100.0)

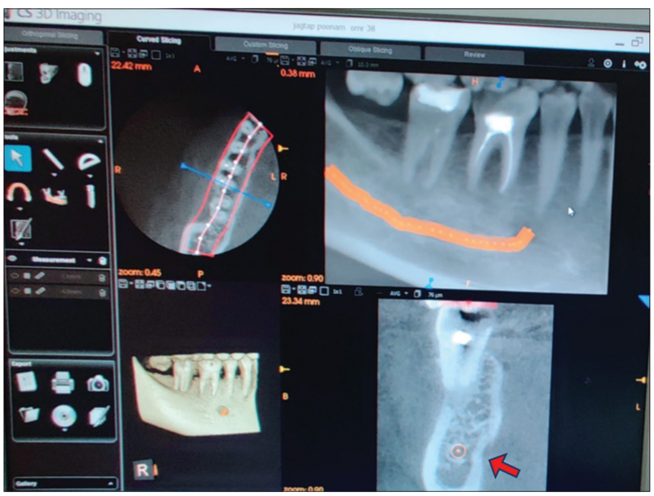

Figure 1: Showing how the image is traced to the deepest concavity (Sagittal view) through cone beam computed tomography

Figure 2: Image shows how to locate the deepest concavity

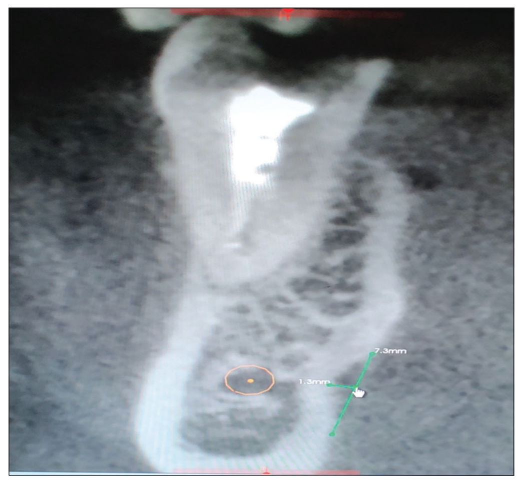

Figure 3: A second line is then drawn from the deepest point of the fossa perpendicular to the first line (Measured with the caliper of the software in mm). The slice in which the fossa was deepest was chosen as a representing maximum depth of submandibular fossa

Figure 4: Third measurement was done by joining the crest of the alveolar bone to the point of the greatest depth

- Distance from mental foramen to submandibular gland fossa was (24.3 mm) shown in [Figure 5].

RESULTS

The following statistical methods were employed in the present study.

- Descriptive statistics, mean and standard deviation.
- Independent sample *t*-test

Statistical Analysis

Descriptive and analytical statistics were done. Independent sample *t*-test was used to compare difference in gender and age with measured anatomical landmarks of submandibular gland fossa showing frequency distribution using CBCT images [Figure 6]. SPSS (statistical package for social sciences) version 20.1 (Chicago, USA Inc.,) software was used.

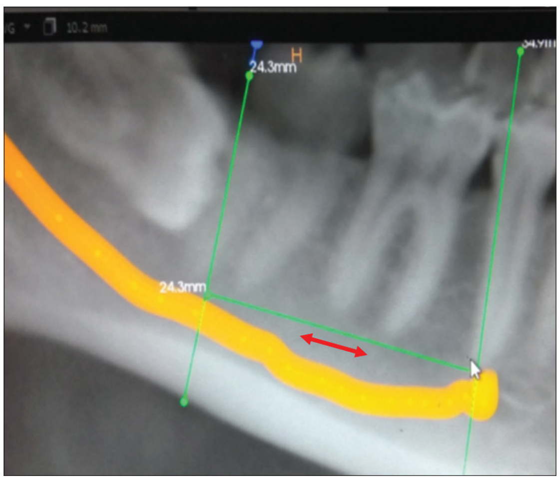

Figure 5: Distances from mental foramen to submandibular fossa

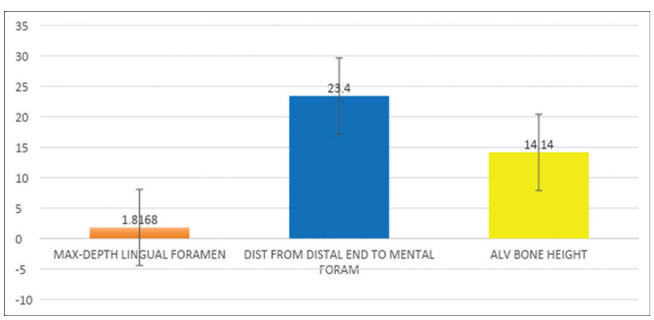

Figure 6: The frequency distribution of anatomical landmarks of submandibular fossa on cone beam computed tomography images

Analysis of variance compared the mean values and standard deviation for mandibular measurements in male and female [Table 2]. The gender did not differ significantly in all measurements [Table 2] ($P > 0.05$).

100 samples were taken to calculate greatest depth of submandibular fossa. Among them, 56 (56.00%) were males and 44 (44.00%) were females. The average depth was 2.0 ± 2.11 (mean value ± SD). The minimum depth was 0.5 mm and maximum depth was 3.70 mm. Independent sample *t*-test did not demonstrate any deference among the age group.$^{\#}P > 0.05$ is statistically not significant.

DISCUSSION

This retrospective study carried out on dentate patient with a total of 100 CBVI scans (single volume) of the mandibular posterior region were selected for the study. The records or the scan volumes of 56 males and 44 females were included in the study [Table 1].

The depth of submandibular gland fossa was found to have the maximum depth of 3.70 mm, minimum 0.5 mm, irrespective of age and gender.

In the posterior mandibular region before implant placement, it is mandatory to know the depth of submandibular gland fossa,[3] i.e. deeper fossa,[4] if undiagnosed before the implant placement of the implant could lead to the perforation of lingual plate,[5] thus causing bleeding from iatrogenic injuries in the floor of the mouth.[5] A perforation at the molar area can be serious complication then to be in mandibular symphysis region as this region contains branches of sublingual, submental, and mylohyoid arteries.[6] It should be thus emphasized that prior to implant placement the height and depth of mandibular bone in the region of submandibular gland fossa should decide the diameter of the implant to eliminate risk of perforation.[7]

Table 2: Association of age with variables using independent sample test

Parameters	Age (in years)	*n*	Mean	Standard deviation	Standard error mean	*t*-test#
Max-depth lingual concavity	>35	26	1.8769	0.47859	0.09386	0.705
	<35	74	2.0608	0.44635	0.28438	
Distance from distal end to mental foramen	>35	26	24.4577	5.56656	1.09169	0.353
	<35	74	23.0622	6.86908	0.79851	
Alveolar bone height (from crest to lingual concavity)	>35	26	14.5192	2.34385	0.45967	0.345
	<35	74	14.0135	2.33363	0.27128	

The depth of the fossa males was 1.86 mm and females was 1.74 mm showing no gender influence on depth of SGF, whereas according to Acar[8] and Kamburo, glu[9] in 2014 found that the average depth and volume values for submandibular fossa were 31.5 mm and 30.7 mm and 1.3 mm and 26.5 mm^3 for sublingual fossa, respectively among the two age criteria >35 years and < 35-year depth to be more in elderly patient which could be attributed to bone remodeling. Whereas in our study, maximum depth of submandibular gland fossa was found 3.70 mm, minimum was 0.5 mm, irrespective of age and gender.

de Souza[10] in 2016 studied of which forty-one scans (41%) were from male patients and 59 (59%) were from female patients. Patient age ranged between 18 and 84 years with an average age of 51.37 years. The submandibular gland fossa depth and implant-bone thickness had a significant effect on the variability of the sample (46.1% and 22.3%, respectively). In our study, both the gender did not show significantly in all measurements [description is given in Table 5] ($P > 0.05$).

100 samples were taken to calculate greatest depth of submandibular fossa. Among them, 56 (56.00%) were males and 44 (44.00%) were females. The average depth was 2.0 ± 2.11 (mean value ± SD). The minimum depth was 0.5 mm and maximum depth was 3.70 mm.

Marc Q in 2003[6] found the deepest point of submandibular gland fossa (with a depth of 6 ± 2.6 mm) with a distance of the deepest fossa to the alveolus height in that area ranging from 4.2 mm to 11.9 mm.[6] The morphologic parameters were influenced neither by age nor by gender.[6] Whereas in our study, minimum depth was 0.5 mm and maximum depth was 3.70 mm with age <35 years having dentulous dentition. Furthermore, in our study, the distance of the deepest portion of the fossa to the alveolus found 14.8 mm in patient >35 years and <35 years, 14. 01 mm.

With the advance in technology such as cone beam computerised tomography, with third dimension of submandibular gland fossa and its relation to its alveolar ridge can be appreciated more accurate lately.[11] This should lid to predictable dental implant replacement with less risk of perforation in submandibular gland fossa.[12]

CONCLUSION

For year's researcher have been trying to evaluate submandibular gland fossa by using conventional radiography such as IOPA and OPG's (orthopantomographs).[13]

Clinician palpation is usually not a reliable to evaluate submandibular gland fossa; on the other hand,[14] correctional image obtained from CT and CBCT is seen to how favorable outcome.

In the present study, the maximum depth of submandibular gland fossa was (3.7 mm) and minimum (0.5 mm) with mean of (1.68 mm). The average/mean distance from distal end of the mental foramen to deepest point of submandibular gland fossa was (23.4250) mm.

The mean value of measuring the height from the deepest point of submandibular fossa till the alveolar crest is (14.1450) mm. We thus found that gender and age had no influence on the dimension of the fossa.[15,16]

It can be concluded that submandibular fossa is well perceived only by cross-sectional imaging.[17] Images acquired using two-dimensional (height and width)[18,19] radiography cannot reveal valuable information in the third dimension (depth).[20] This fact limits its use. In certain situations, for example, deep SF for implant selection, 3D visualization of the anatomical limitation is desirable.[21-23] In those circumstances, 3D imaging provided by CBCT is extremely valuable.[20] In comparison to panoramic radiograph, the use of CBCT can greatly improve the visualization leading to a more definitive diagnosis and the best possible treatment plan.[8,24,25]

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