International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 12(D); December 2018; Page No. 16632-16635
DOI: http://dx.doi.org/10.24327/ijcar.2018.16635.3080

Research Article

ASSESSMENT OF SUBMANDIBULAR FOSSA FOR DENTAL IMPLANTS – A RETROSPECTIVE 3 DIMENSIONAL CONE BEAM COMPUTED TOMOGRAPHIC STUDY

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A R T I C L E I N F O

Article History:
Received 13th September, 2018
Received in revised form 11th October, 2018
Accepted 8th November, 2018
Published online 28th December, 2018

Key words:
Cone beam computed tomography, mandible, implants, submandibular fossa, lingual concavity.

A B S T R A C T

Introduction & Aim: Implants has a choice in patients treatment plan has become very popular in recent times. CBCT plays an important aid in preoperative assessment for implant placement. This study aims to evaluate the depth and angle of concavity of the lingual depression of submandibular salivary gland fossa and its variations among gender.
Materials & Methods: A retrospective analysis of the depth and angle of concavity of the lingual depression of the submandibular gland fossa was assessed in 100 Cone Beam Computed Tomographic images in planmeca promax 3D mid proface unit with romexis software, taken for the purpose of implant assessment in the Department of Oral Medicine and Radiology, Meenakshi Ammal Dental College, Chennai. The deepest regions of submandibular gland fossa and the concavity angle between the alveolar crest and the upper limit of the infra alveolar canal were measured. The data was tabulated and then subjected for statistical analysis using IBM SPSS software version 19.
Results: A probability value (p value) < 0.05 was obtained by chi square test. According to the results, the deepest point in most of the cases was above the dentoalveolar canal and also as the depth increases the angle also increases. The mean angle was 38.9^0 in females and 36.7^0 in males. The average depth was 1.46 mm in females and 1.39 mm in males.
Conclusion: Cross sectional CBCT imaging provides an excellent delineation of mandibular anatomy and assessment of depth of submandibular gland fossa for implant placement and other surgical procedures. Submandibular fossa location, size, depth, its possible anatomical variations can be fully assessed with the help of CBCT prior to implant placement or any surgical procedure in the posterior mandible. There by preventing haematoma at floor of mouth which is the common complication of lingual perforation leading to an implant failure.

INTRODUCTION

The dental implants are in the replacement of missing teeth. For a successful implant planning the morphological features of the bone and the relationship between the vital anatomical structures and implant placement plays an important role, which if not properly planned can lead to bone perforation, followed by inflammation, haematoma, infection, nerve paraesthesia etc (Sina *et al*, 2018). The damage to the inferior alveolar canal during placement of implants can result in paraesthesia or numbness of the chin and corner of the mouth it can also further lead to the loss of tooth vitality within a quadrant as the neurovascular bundle within the canal supplies all the teeth (Nickenig *et al*, 2015). Perforation of the lingual plate in the submandibular fossa may be asymptomatic but can also result in damage of the sublingual arteries, leading to potentially life-threatening hemorrhage thereby causing obstruction of the upper airways[3,4]. For an Implant placement in the posterior mandible region, the inferior alveolar canal and the submandibular gland fossa are the two most important anatomical landmarks which should be assessed properly before the placement to prevent any complication in this anatomically significant location.

The submandibular gland fossa also known as the lingual concavity is located below the mylohyoid ridge of the posterior mandible. It is an important landmark of the mandible bone where the submandibular gland resides. Anatomical variations of submandibular fossa can occur as deeply prominent fossa or flat area with no depression, stafne cyst is another rare anatomical variant of this region. Mandible with deep lingual concavity pose a potentially increased risk of lingual cortical perforation during surgery particularly in an endosseous implant placement[5,6]. It is reported that the long span edentulous ridges have higher chances for perforations. As reported by Good acre *et al* haematoma of floor of the

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mouth is reported 24% being one of the most common complication of implant failure (Goodacre *et al*, 2003).

Various assessments like the osteometry, diagnostic casts and palpation of the ridges are done prior to implant placement to assess the anatomical areas of the region but this cannot be applicable for assessment of the posterior mandible (Parnia *et al*, 2010). Cone beam computed tomography as a modern imaging resource provides an accurate three dimensional assessment of the gland fossa there by giving an excellent delineation of the of the mandibular anatomy and the maximum depth of the concavity. Based upon this assessment the depth, size, length and angulation of implant placement vary for each patient. Radiographically this submandibular gland fossa is seen as an undefined ovoid radiolucency bilaterally in the posterior mandible (soulilhussaini *et al*, 2016). As Panoramic and periapical radiographs the most commonly used conventional radiographs in dental practise provide only a two dimensional view of a three dimensional structure, the gland fossa cannot be clearly assessed in most cases with superimposition of the other anatomical landmarks of the area like the thinning of the mandible as well as the location below the myelohyoid line and the trabaculae bone pattern .CBCT with its 3D technology provides us with an accurate evaluation of the osseous structures in the maxillofacial region(Pinsky *et al*, 2010). Multislice computed tomography (CT) is also used in the assessment of maxillofacial region prior to any surgical procedure (Kawamata *et al*, 2000) As it is very expensive and high radiation dose compared to CBCT, the latter serves as a promising tool in assessment of the anatomical structures prior to any surgical procedure. With this background this study aims to assess the depth and angle of concavity of the lingual depression of submandibular gland fossa and its variations among gender.

MATERIALS AND METHODS

This study included a total of 100 retrospective analysis of CBCT images taken from the Department of Oral Medicine and Radiology, Meenakshi Ammal dental college and hospital, Chennai taken using Planmeca Promax 3D mid proface unit using Romexis software which were taken for various dental procedures. The inclusion criteria included patients of partially or completely edentulous ridges in relation to the posterior mandible region. Images with any pathology, fractures of the mandible and artifacts pertaining to the region of interest were excluded in this study.

The inferior alveolar nerve canal tracing is done after locating in panoramic imaging and status of the canal is assessed. Subsequently the cross section of the submandibular gland fossa was evaluated in cross sections at 1 mm intervals with 1 mm thickness and the deepest region of the fossa is determined. A line is drawn in relation to the upper and lower limit of the nerve canal.

To measure the depth, at first a 'line A' is drawn connecting the uppermost and the lower most prominent point of the gland fossa. Now a line 'B' is drawn tangential to line A from the deepest region of the gland fossa using the length measurement tool. This gives the deepest region of the gland fossa and it is noted down.

To measure the angle of concavity from the deepest region of the gland fossa a line C is drawn to the upper most prominent area of the gland. From this upper most prominent area another line D is drawn tangential to the upper limit of the inferior alveolar canal. The angle formed between D and C is measured using the angle measurement tool and the angleof concavity is noted down. (Fig:1)

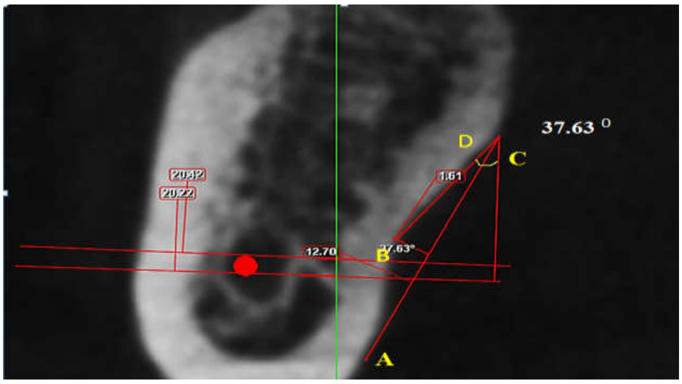


Fig 1 the depth and angle of concavity measured in the cross section of gland fossa.

Apart from this another parameter is noted in this study that is the starting point of concavity to elicit the relationship between the undercut and the inferior alveolar nerve. To determine this a line 'G' is drawn in relation to the alveolar crest region and another line 'E' to the upper limit of the canal. Now the area between these two are divided into three equal compartments such as the upper third, middle third and the lower third. Thus providing the location starting point of the concavity in relation to the inferior alveolar canal (Fig 2).

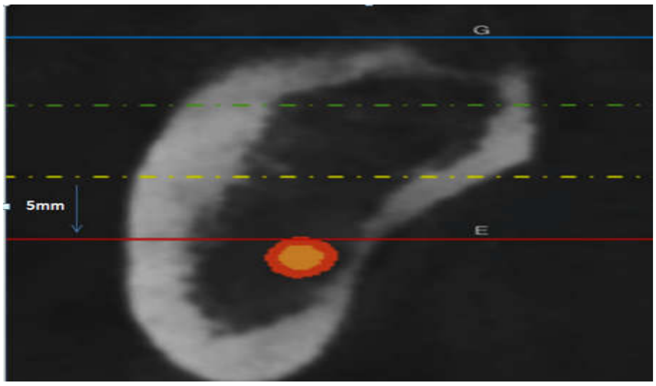


Fig 2 Starting point of the concavity relation to the inferior alveolar nerve.

The parameters depth of the gland fossa, angle of concavity and the location of the starting point of concavity determined is tabulated and subjected for statistical analysis using IBM SPSS software version 19.

RESULTS

The mean age of the study population is $48.2\ ^{\pm}10$ years with gender distributed equally between males and females. The average depth of the gland fossa was 1.46 mm in females and 1.39 mm in males with a std.dev. of 0.067 mm respectively. Thereby providing a p value of 0.048 indicating there is a significant difference among gender. With females having greater depth when compared with the male population.

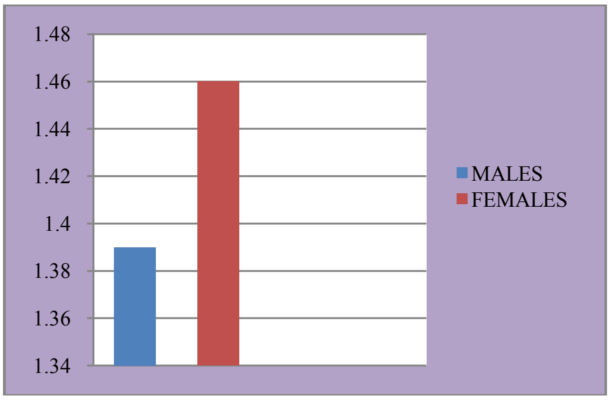
The mean angle of concavity of the gland fossa was $38.9\ ^{0}$ in females and 36.7^{0} in males respectively with a std. dev. Of 2.17^{0} with p value of 0.08 indicating there is a significant difference between the females and the male population (Tab: 1; graph 1& 2). It was also noted that as the depth of the gland fossa increases the angle of concavity also increases and viceversa. Based upon the starting point of the concavity in relation to inferior alveolar nerve in most of the cases it was present in the middle third ie tangent to the nerve in 80% of the cases and 15 % of the cases in the lower third close to the canal and in 5 % of cases it was present in the upper third far above the canal . Pearsons correlation test based upon the age showed a 'r 'value of 1.00 for depth and 0.05 for angle of concavity and the 'p' value of 0.01 for depth and 0.095 for angle of concavity (tab: 2). The analysis showed that the study was significant with depth and angle of concavity was higher in females when compared to the males.

Tab 1 Mean; *Std. dev. ; *t value ;* p value

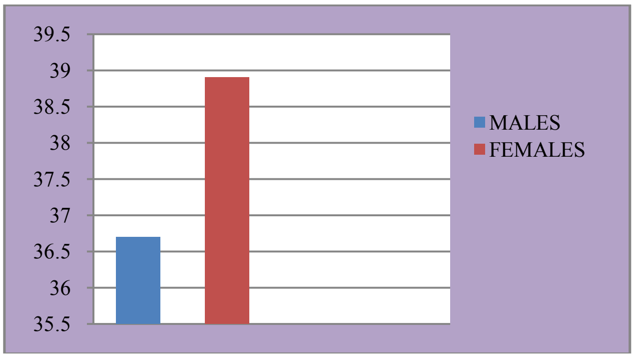
	GENDER	N	Mean	Std. Deviation	Mean difference	t value	p value
DEPTH	Female	50	1.462	.466	.067	.396	.048
	Male	50	1.395	.491			
ANGLE	Female	50	38.963	5.735	2.175	.847	.097
	Male	50	36.788	7.270			

Tab 2 Correlation between depth , angle and age. *Pearson correlation test

		DEPTH	ANGLE
AGE	r value	1.000	.005
	p value	.010	0.09
	N	100	100



Graph 1 Mean Depth of concavity in males and females



Graph 2 Mean Angle of concavity in males and females

DISCUSSION

In the current study the mean values of the submandibular gland fossa depth were 1.46±0.46 mm and 1.39± 0.49 mm in females and males respectively. It was significantly higher with female patients than in male patients indicating the width and thickness of the bone at this point were less in males. And the average angle of concavity was 38.9 ^{0} ±5.7 and 36.7^{0}± 7.2 in females and males respectively.

In relation to the depth of concavity it was more in females and depth of concavity was less than 2mm this was correlating with the study of Parnia *et al* 2010 done in multislice CT images in Iran population where the average submandibular depth was more in females and the average depth was less than 2 mm[8].In the study done by Seval bayrak *et al* in CBCT in Turkey population 2010 the average depth of the gland fossa was less than 2mm and he also quoted that the age of the patients did not have any effect on the fossa depth[12]. According to Kamburoglu *et al* a study done in CBCT in 2015 the average concavity depth was found to be 1.3 mm respectively indicating the average depth to be less than 2mm [13].

In relation the concavity angle it was more in females than males this was correlating with the study of Panjnoush *et al* in CBCT in Iran population 2016 were the average concavity angle was more in female patients when compared with male patients [14].

Our study was in contrast with the study of Nazani *et al* in CBCT in Iran population 2018 were on comparison among gender the average depth was more in male patients whereas in our study the depth was more in female patients but the mean depth was less than 2mm and was correlating with our study this may be due to different races of the population[1].

Chan *et al* in his study done in CBCT in Michigan population 2010 quoted that the incidence of lingual plate perforation is to be 1.1 to 2 % of the cases during implant placement .The average depth was similar in males and females and angle of concavity was more in males when compared to females in his study. This was not correlating with our study as females had a greater depth and angle of concavity value when compared with males. This difference may due to different race of population taken[15].

CONCLUSION

Preoperative imaging is imperative for the success of implant placement.Cone Beam Computed Tomography being an advanced technology acts as a useful diagnostic tool that allows an accurate three dimensional (3D) assessment of submandibular fossa thereby the location, size, depth, its possible anatomical variations can be fully assessed prior to any surgical procedure in the posterior mandible. Adequate knowledge regarding the morphological features of the region is important to prevent perforation of the lingual alveolar plate during implant placement. Measuring the bone thickness at this point needs great attention, compared to the alveolar ridge. By analyzing these parameters in reference to the anatomy of lingual concavity utilizing CBCT preoperative diagnostics can be performed to ensure a proper implant placement.

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How to cite this article:

Saraswathi Gopal.K and Sushmitha.S (2018) 'Assessment of Submandibular Fossa for Dental Implants – A Retrospective 3 Dimensional Cone Beam Computed Tomographic Study', *International Journal of Current Advanced Research,* 07(12), pp. 16632-16635. DOI: http://dx.doi.org/10.24327/ijcar.2018.16635.3080

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