

# Determination the Position of Greater Palatine Foramen in Relation to Alveolar Ridge by using Cone Beam Computed Tomography

Weaam H. Abdullah<sup>1</sup>, Lamia H. AL Nakib<sup>2</sup>

<sup>1</sup>B.D.S, Department of Oral and Maxillofacial Radiology, College of Dentistry, University of Baghdad, Iraq Baghdad

<sup>2</sup>B.D.S, M.Sc. Professor (Oral Radiology), Al Israa University, Department of Dentistry, Iraq Baghdad

**Abstract:** *Background:* The use of the cone beam computed tomography for analyzing the position of the greater palatine foramen is important in dentistry to avoid complication associated within the area.. The aims of the current study, is to measuring the distance from the greater palatine foramen to alveolar ridge by using cone beam computed tomography and compare the change in distance within the age. *Materials And Methods:* This prospective study included 60 Iraqi patients (28males and 32 females) who selected according to availability of Inclusion criteria, which include age range (21 - 60 years), with no dentofacial deformities or pathological lesion at the maxilla. Measurements were taken for the distance from the greater palatine foramen to alveolar ridge in the axial view by using cone beam computed tomography. *Results:* The average distances of the greater palatine foramen to alveolar ridge was  $5.16 \pm 0.84$  mm respectively, there was significant difference of distance according to age. *Conclusion:* The use of cone beam computed tomography could prevent the complications of procedures carried out in the region of greater palatine foramen. The average distance from the greater palatine foramen to the alveolar ridge was statistically significantly differing according to age.

**Keywords:** Greater palatine foramen, Alveolar ridge Cone beam computed tomography.

## 1. Introduction

Greater palatine foramen (GPF) represents the inferior opening of the greater palatine canal (GPC), positioned at backside of the hard palate., on the palatal side between the maxillary 2nd and 3rd molars or medial to the maxillary 3rd molar [1]. Accurate GPF positioning is required to avoid complication associated with the maxillary nerve block palatal free vascular flaps surgery, maxillary sinus, cleft palate, or during graft of palatal mucosa for periodontal surgery [2,3,4].

Predominantly, the previous studies analyzing the position of GPF on dry skulls, thus giving an adequate information on the gender, age, and ethnicity of the subjects[5], 3D cone beam computed tomography (CBCT) are becoming commonly presented for use in maxillofacial applications due to its diagnostic capability and minimizing radiation dose to the tolerant, equivalent to (3% - 20%) of a conventional CT radiation dose, and comparable to 2D X-ray radiation dose[6,7]. So, the purpose of this study was to investigate the GPF position by measurement the distances from the greater palatine foramen to alveolar ridge in the axial view by using (CBCT) data and providing essential information about the variation GPF position with age in Iraqi patients.

## 2. Materials and Methods

A prospective study of CBCT scan for (60) Iraqi adult patients (32 females and 28 males) with age between (21-60) years attending Oral and Maxillofacial Radiology department of Al Sader Specialized Health Center for dental treatment in Baghdad city who underwent CBCT scans for different purposes since November 2016 to March 2017.

The patients who visited a diagnostic center were selected after considering the inclusion criteria which are: age range (21 - 60 years), no dentofacial deformities or pathological lesion at the maxilla, maxillary lateral incisor teeth and at least one of maxillary molars for both right and left sides must be present.

All patients had their CBCT scans taken for other purposes and they had informed consent for participation in this study. The sample subject was divided into four age groups with 15 subject in each group:

- 1) **Group 1:** consists of 8 females and 7 males with age ranged between (21-30) years.
- 2) **Group 2:** consists of 9 females and 6 males with age ranged between (31- 40) years.
- 3) **Group 3:** consists of 8 females and 7 males with age ranged between (41-50) years.
- 4) **Group 4:** consists of 7 females and 8 males with age ranged between (51- 60) years

The CBCT examinations were carried out for every patient with Kodak 9500/Care stream (France), full rotation scan was performed with the size of field of view will be 18× 20.6cm diameter and the exposure parameters of radiographic machine include: voxel size 300, KV 90, MA 10. The analysis was conducted using the distance measuring tool of care stream (CS 3D) software. Intra- and inter-examiner agreement was performed (Coefficient of variance and paired T test were used). All data were evaluated using SPSS software version 19 package. All images were obtained with volume 1 (high-resolution) and high-contrast options. The statistical analysis was made by using SPSS 20.0.0, Minitab 17.1.0, MedClac 14.8.1 software package was used to make the statistical analysis. A paired T test and ANOVA test used in statistics of study. The GPF, the position determined by measuring the distance from the

foramen into alveolar ridge, firstly entering in the depth of the view until reaching the neck of teeth (cement -enamel junction area), a tangential line to the palatal side of upper posterior teeth was drawn, this line starting from distal margin of maxillary lateral incisors in both right and left side to the end of AR. Then with software reconstruction the position of GPF within the depth of palatine bone was determined which is ended by GPF, then perpendicular line from the a tangential line to the medial wall of GPF passing through the center of the foramen represent distance from the GPF to the AR was done as shown in figure (1), that's help as for determination the position of GPF according to AR.

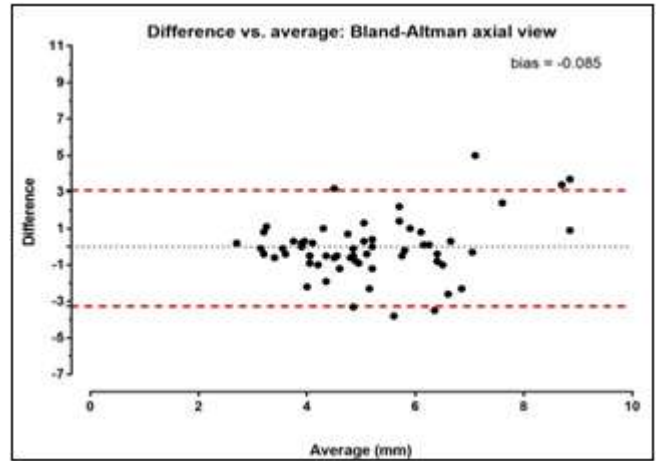


	Beta	R <sup>2</sup>	P value
Average of distance from greater palatine foramen to alveolar ridge axial view	-0.244	0.059	0.061
Beta: correlation coefficient, R <sup>2</sup> : coefficient of determination			

**Figure 1:** Axial view A and B showing method of measuring distance from GPF to AR.

### 3. Results

Sixty patients (32 females and 28 males) with mean age of the  $41.1 \pm 12.2$  year were examined. The average distance from the GPF to the AR was  $5.16 \pm 0.84$  mm ( $5.12 \pm 1.81$  mm on the right side and  $5.21 \pm 1.43$  mm on the left side) and illustrated in figure 2.



**Figure 2:** Bland-Altman plot the average distance from GPF to AR

Average distance from GPF to AR in axial view; in age group 1 was  $6.06 \pm 1.61$  mm, age group 2 was  $4.83 \pm 1.66$  mm, age group 3 was  $4.88 \pm 1.07$  mm, and in age group 4 was  $4.89 \pm 0.78$  mm. The average distance from the GPF to the AR axial view in age group 1 was significantly higher than the rest of the groups 2, 3 and 4, there was no significant difference between these age groups as illustrated in table (1), the agreement between right and left sides in group 2 were more (since the ICC is higher) than other age groups as illustrated in table (2).

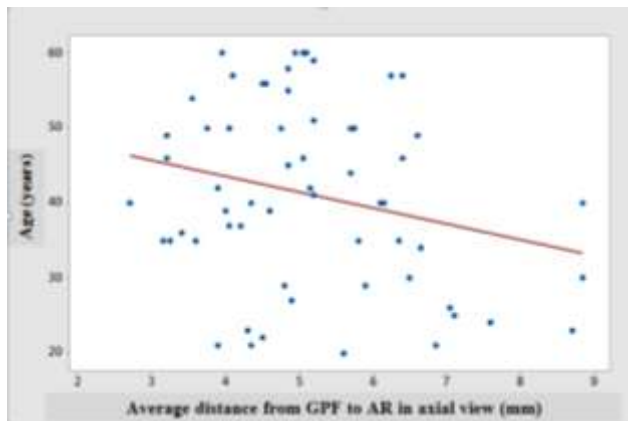
**Table 1:** The comparison of the distances from the GPF to the AR in axial view according to age groups

Age groups	Group 1	Group 2	Group 3	Group 4	P value
Number	15	15	15	15	-
Average distance from GPF to AR axial view (mm)	$6.06 \pm 1.61$	$4.83 \pm 1.66$	$4.88 \pm 1.07$	$4.89 \pm 0.78$	0.041

**Table 2:** Comparison between left and right sides distance from GPF to AR in axial view in all age groups

Age groups	Right	Left	P value	ICC	Agreement
Group 1	$6.36 \pm 2.45$	$5.76 \pm 1.53$	0.370	0.244	Poor
Group 2	$4.60 \pm 1.82$	$5.05 \pm 1.71$	0.146	0.778	Excellent
Group 3	$4.85 \pm 1.10$	$4.91 \pm 1.36$	0.854	0.499	Fair
Group 4	$4.68 \pm 0.91$	$5.11 \pm 0.96$	0.141	0.402	Fair
ICC: intra-class correlation coefficient					

There was inverse correlation between age and distance from the GPF to the PH as illustrated in table (3) and figure (3). Table (3): Relationship between age and distances from GPF to AR



**Figure (3.14):** Scatter plot of GPF to AR distance (mm) versus age (years)

#### 4. Discussion

The position of GPF requires further investigations to establish an exact reference point for localizing the foramen because of various studies have recognized different results between ethnic groups, in addition the GPF position were performed on dry skulls in most of the studies, thus giving imperfect information on the gender, age, or ethnicity of the patient [5,8,9,10,11].

The CBCT provides precise measurements with a less radiation dose and shorter exposure time in comparison to CT[7,8]. In the current study using CBCT, data image of Iraqi subjects to assess the GPF position in alveolar ridge in axial view with compare distances measurements age.

In the present study the average distance of the GPF to the AR was  $5.16 \pm 0.84$  mm ( $5.12 \pm 1.81$ mm on the right side and  $5.21 \pm 1.43$ mm on the left side), the figure (2), which is represent Bland-Altman plot for left and right sides of distance from the GPF to AR ,there was low bias which lead to high agreement between left and right sides, the differences were within the confidence interval as the average increases (from left to right on the horizontal axis) 95% of variable within the confidence interval, there are three measurement values out of interval, this may be explained either as true valuable values or discrepancy in measuring data, It's clearly seen from the results of table (1), group1 was significantly higher than the rest of the groups, however the agreement between right and left side in second age group were more (since the ICC is higher) than other age groups as illustrated in table (2). The result of table (3) and figure (3) in the present study show inverse correlation between age and the distance from GPF to AR ,**Baxter-Jones et al., 2011; Birkhold, 2016** stated that the gain of bone mass was during puberty and reaching a maximum at the second decade of life ending then decreasing subsequently[12,13]. As a result, bone mass decreases with aging, mass decreases and construction changes, on other hand within the limit of our knowledge GPF to AR distance previously not investigated according to age so there is limitation in comparison of the result with other studies. A limiting factor in the current study was the small sample size, thus, we suggest evaluating the GPF position on larger sample with greater difference in the range of age group.

#### 5. Conclusion

The average distances from the GPF to the AR was statistically significantly differ according to age, with inverse correlation between age and the distance from GPF to AR.

#### References

- [1] Arx, T.V. &Lozanoff, S. Clinical Oral Anatomy: A Comprehensive Review for Dental Practitioners and Researchers, textbook, 1<sup>st</sup>edi. AG Switzerland, Springer nature 2016. p 204-218
- [2] Chrcanovic BR, Custódio AL. Anatomical variation in the position of the greater palatine foramen. Journal of oral science. 2010;52(1):109-13.
- [3] Nimigean V, Nimigean VR, Buțincu LA, Sălăvăstru I, Podoleanu L. Anatomical and clinical considerations regarding the greater palatine foramen. Rom J MorpholEmbryol. 2013 Jan 1;54(3 Suppl):779-83.
- [4] Tomaszewska IM, Tomaszewski KA, Kmiotek EK, Pena IZ, Urbanik A, Nowakowski M, Walocha JA. Anatomical landmarks for the localization of the greater palatine foramen—a study of 1200 head CTs, 150 dry skulls, systematic review of literature and meta-analysis. Journal of anatomy. 2014 Oct 1;225(4):419-35.
- [5] Ikuta CR, Cardoso CL, Ferreira-Júnior O, Lauris JR, Souza PH, Rubira-Bullen IR. Position of the greater palatine foramen: an anatomical study through cone beam computed tomography images. Surgical and Radiologic Anatomy. 2013 Nov 1;35(9):837-42.
- [6] Asha ML, Arun Kumar G, SattigeriAnupama V, Raja Jigna V, Diksha M. Cone beam computed tomographic analysis of anatomical variations of greater palatine canal and foramen in relation to gender in South Indian population. Oral Health Dent Manag. 2015;14:384-90
- [7] Rahman VF, Fatah AA. Localization of Maxillary Impacted Canine Using Cone Beam Computed Tomography for Assessment of Angulation, Distance From Occlusal Plane, Alveolar Width and Proximity to Adjacent Teeth. Journal of Baghdad College of Dentistry. 2017 Mar 13;29(1):70-5.
- [8] Mellema, J.W. and Tami, T.A., 2004. An endoscopic study of the greater palatine nerve. American journal of rhinology, 18(2), pp.99-103.
- [9] Methathrathip, D., Apinhasmit, W., Chompoonpong, S., Lertsirithong, A., Ariyawatkul, T. and Sangvichien, S., 2005 Anatomy of greater palatine foramen and canal and pterygopalatine fossa in Thais: considerations for maxillary nerve block. Surgical and Radiologic Anatomy, 27(6), pp.511-516.
- [10] Saralaya, V. and Nayak, S.R., 2007. The relative position of the greater palatine foramen in dry Indian skulls. Singapore medical journal, 48(12), p.1143.
- [11] Klosek, S.K. and Rungruang, T., 2009. Anatomical study of the greater palatine artery and related structures of the palatal vault: considerations for palate as the subepithelial connective tissue graft donor site. Surgical and radiologic anatomy, 31(4), pp.245-250.
- [12] Baxter-Jones, A. D., Faulkner, R. A., Forwood, M. R., Mirwald, R. L. and Bailey, D. A., 2011., Bone mineral accrual from 8 to 30 years of age: An estimation of peak bone mass. J Bone Miner Res, 26: 1729–1739. doi:10.1002/jbmr.412
- [13] Birkhold, A.I., 2016. A 4D imaging approach to monitor bone remodeling. PhD thesis, Berlin university ,p13