



## CBCT-based Morphometric Study of the GPF in Relation to Landmarks Relevant to the Edentulous Maxilla

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**Abstract Background:** The association between the maxillary denture-bearing area and the greater palatine neurovascular bundle may be affected by anatomical variation of the Greater Palatine Foramen (GPF). Using Cone-Beam Computed Tomography (CBCT), this study assessed GPF and greater palatine canal measures and looked at how they varied by side, gender and age. **Methods:** Seventy CBCT scans from 30 men and 40 women who were at least 18 years old were included in this retrospective cross-sectional investigation. The scans were selected from a private radiology archive during January 2025 and January 2026. Ninety-three eligible consecutive scans were selected among which 23 cases were excluded and 70 patients were included. One-hundred and forty foramina were obtained from the evaluation of both sides. Multiplanar reconstructions were used to quantify the canal emergence angle, GPF-to-midpalatal suture distance and GPF-to-alveolar crest distance. Paired-samples t-tests were used to compare bilateral measurements. Independent-samples t-tests and patient-level bilateral means were used to compare gender and age groups. Relationships between measurements were evaluated using Pearson correlation. **Results:** The canal emergence angle was  $123.69 \pm 8.23^\circ$ , the GPF-to-midpalatal suture distance was  $13.02 \pm 1.68$  mm and the GPF-to-alveolar crest distance was  $12.42 \pm 3.37$  mm. The left side had a considerably larger GPF-to-alveolar crest distance than the right ( $12.71 \pm 3.27$  versus  $12.12 \pm 3.47$  mm;  $p = 0.009$ ). Additionally, it was considerably higher in patients between the ages of 18 and 49 than in those 50 years and over ( $13.22 \pm 3.20$  versus  $11.66 \pm 3.14$  mm;  $p = 0.043$ ). There was little side-to-side variation in midpalatal distance and emergence angle. There were no discernible relationships between measures or gender differences. **Conclusion:** There was significant individual diversity in GPF anatomy. Its association to the alveolar crest was impacted by age and anatomical side. When current CBCT imaging is clinically available for examination, patient-specific assessment may promote proper maxillary full denture contouring and lessen pressure on the greater palatine neurovascular area.

**Key Words** Cone-Beam Computed Tomography (CBCT), Greater Palatine Foramen, Greater Palatine Canal, Morphometric Analysis, Edentulous Maxilla, Alveolar Crest, Midpalatal Suture, Prosthodontics

### INTRODUCTION

The inferior terminus of the greater palatine canal is represented by the bilateral Greater Palatine Foramen (GPF), which is situated in the posterolateral area of the hard palate. The palatal mucosa, glands and gingiva are supplied by the greater palatine nerve and veins, which emerge via the GPF and move anteriorly over the palate. Because damage to the greater palatine neurovascular bundle may result in bleeding, altered sensation, or postoperative discomfort during dental and surgical operations involving the posterior maxilla, accurate knowledge of the location and course of these structures is clinically significant [1].

There is significant individual and population-related diversity in the GPF's morphology and location. Its size, shape, location in relation to the maxillary molars, distance from the midpalatal suture and relationship to the alveolar ridge have all been found to differ [1,2]. Measurable differences in the GPF diameter and its distances from the midline maxillary suture and alveolar ridge were found in a CBCT study of Brazilian subjects [2]. Anatomical findings from one population may not be directly transferable to another, as demonstrated by a study done in a Sri Lankan population that revealed variations in GPF measures based on gender and side [3].

Additionally, the length, direction, curvature and angulation of the greater palatine canal vary. The canal most often follows an anterior-inferior direction in the sagittal view, according to Howard-Swirzinski *et al.*'s [4] observation of multiple geometric patterns in the coronal and sagittal planes. The direction in which the neurovascular bundle exits onto the hard palate may be affected by these changes. As a result, evaluating the canal emergence angle in addition to the GPF's position may offer a more thorough comprehension of the posterior palatal region's anatomy.

The GPF's anatomical connection to the alveolar crest and midpalatal suture is pertinent to the clinical assessment of the edentulous maxilla. The spatial connection between the residual ridge and fixed palatal structures may change as a result of gradual resorption of the alveolar ridge after tooth removal. The GPF and its neurovascular contents may therefore be located closer to the functional denture-bearing area in patients with significant ridge resorption. While minimizing undue pressure on delicate anatomical features, complete denture impressions and denture-base extensions should precisely replicate the supporting tissues [5]. Therefore, understanding the location of the GPF may help doctors assess the posterior palatal architecture and decide whether customized alleviation or contouring is necessary.

Superimposition and geometric distortion make it difficult for conventional two-dimensional radiographs to show the GPF and greater palatine canal. On the other hand, axial, coronal and sagittal plane measurements are possible with Cone-Beam Computed Tomography (CBCT), which offers high-resolution multiplanar viewing of maxillofacial structures. The location of the GPF, its relationship to nearby landmarks, palatal soft-tissue thickness and variations related to patient characteristics have all been satisfactorily evaluated by prior CBCT investigations [2,3,6]. For the retrospective morphometric assessment of the greater palatine region, CBCT is a suitable imaging technique.

Despite the clinical importance of the GPF, limited information is available regarding its anatomical variation in the Kurdish population, particularly in relation to landmarks relevant to maxillary complete denture construction. Population-specific assessment may provide measurements that are more applicable to local patients and may support safer, more individualized prosthodontic planning. Therefore, this study aimed to evaluate the anatomical variations of the GPF and greater palatine canal using CBCT by measuring the GPF-to-midpalatal suture distance, GPF-to-alveolar crest distance and canal emergence angle. It also aimed to compare these measurements according to gender, age group and anatomical side.

## METHODS

### Patients and Methods

**Study Design and Setting:** Cone-Beam Computed Tomography (CBCT) images from a private radiology institution in Sulaymani, Iraq's digital radiography archives were used in this retrospective cross-sectional investigation. The study assessed anatomical differences between

clinically significant anatomical landmarks for maxillary complete denture extension and the Greater Palatine Foramen (GPF) and greater palatine canal. Every CBCT scan was previously acquired for objectives unrelated to the current investigation, such as diagnosis or therapy.

### Study Population and Sample Selection

The archive was searched for scans obtained between October 2025 and May 2026. A total of 93 potentially eligible scans were screened using consecutive sampling method. Of these, 23 cases were excluded due to reasons like imaging artifact and incomplete patients' records leaving 70 scans for analysis. Participants were categorized as 18-49 years or  $\geq 50$  years. Dental status, number of remaining maxillary teeth, ridge-resorption severity, duration of edentulism and existing denture use were not available in the archive. Both sides were examined, yielding 140 GPF observations. Because all available eligible scans were included, this was a retrospective convenience sample and no a priori sample-size calculation was performed. The subgroup analyses should therefore be interpreted as exploratory, particularly for estimates close to the significance threshold.

### Inclusion Criteria

CBCT scans were included when they met the following criteria:

- Patients aged 18 years or older
- High-quality CBCT images showing complete visualization of the hard palate and greater palatine canal
- Complete visualization of the posterior maxilla
- Absence of significant motion, metallic, or reconstruction artifacts in the region of interest

### Exclusion Criteria

CBCT scans were excluded in the presence of:

- A history of maxillary trauma or surgery
- Congenital craniofacial anomalies
- Maxillary tumors or cysts affecting the palate
- Pathological lesions involving the greater palatine region
- Poor image quality caused by motion, metallic objects, or other imaging artifacts
- Incomplete visualization of the hard palate, posterior maxilla, GPF, or greater palatine canal

### CBCT Image Acquisition

The digital radiography archive of the center was used to get the CBCT pictures retrospectively. To ensure confidentiality, all patient-identifying information was eliminated prior to data collection and analysis. All CBCT scans were acquired using a NewTom GiANO HR unit (Cefla Dental Group, Imola, Italy). The device operates with a high-frequency constant potential generator (90 kV, 2-16 mA) in pulsed mode and a 0.5 mm focal spot. It is equipped with a high-resolution amorphous silicon detector and provides a 16-bit grey-scale dynamic range. Available Fields Of View (FOVs) ranged from 4×4 cm to 16×18

cm, with voxel sizes between 68 and 300  $\mu\text{m}$ . The SafeBeam™ technology automatically adjusted radiation exposure according to patient size to minimize dose.

### Image Analysis and Measurements

Image acquisition and measurement were performed using the NNT® software by Cefla Dental Group, Italy. Bilateral measures were taken and every CBCT image was systematically reviewed. The anatomical parameters listed below were assessed:

#### Distance from the Greater Palatine Foramen to the Midpalatal Suture

On the axial segment, the GPF-to-midpalatal suture distance was measured in millimeters. It was described as the linear distance between the midpalatal or intermaxillary suture and the GPF center.

#### Distance from the Greater Palatine Foramen to the Alveolar Crest

On the coronal segment, the GPF-to-alveolar crest distance was measured in millimeters. It was described as the shortest path between the alveolar crest and the GPF center.

#### Angle between the Greater Palatine Canal and the Hard Palate

On the sagittal section, the canal emergence angle was measured in degrees. It was described as the angle created between the hard palate plane and the long axis of the greater palatine canal.

### Reliability of Observers

The same examiner reexamined a random selection of CBCT images after about one week in order to assess the intra-examiner reliability. While Cohen's Kappa Coefficient was utilized for categorical factors including the number of lingual foramina, canal direction and midline canal position, the Intraclass Correlation Coefficient (ICC) was utilized to assess agreement on continuous variables.

### Ethical Approval

The Ethical approval for this study was obtained from Tishk International University Research Ethics Committee. The approval was granted on June 16, 2026 under the reference code: DEN-ETH-2026-95.

### Statistical Analysis

Statistical Package for Social Sciences (SPSS version 26) was used to analyze the data. While continuous variables were described using means, standard deviations, minimum values and maximum values, categorical variables were displayed as frequencies and percentages. The Shapiro-Wilk test was used to determine whether the distributions were normal. The paired-samples t-test was used to compare measures from the same patient's right and left sides. To account for the paired bilateral observations, the mean of each patient's right and left side measurements was

computed for gender and age group comparisons and the independent-samples t-test was used to compare groups. The associations between the bilateral mean anatomical measurements were assessed using Pearson's correlation coefficient. A p-value of less than 0.05 was regarded as statistically significant and all tests were two-sided.

## RESULTS

Table 1 presents the demographic distribution of the 70 patients. Females accounted for 57.1% of the sample, while males accounted for 42.9%. Regarding age, 48.6% of the patients were aged 18-49 years and 51.4% were aged  $\geq 50$  years. The largest demographic subgroup consisted of females aged  $\geq 50$  years, representing 30.0% of the sample. Females aged 18-49 years represented 27.1%, while males in each age group represented 21.4% of the total sample.

Table 2 summarizes the measurements of the 140 greater palatine foramina and compares the paired right and left sides. The overall mean GPF-midline distance was  $13.02 \pm 1.68$  mm, ranging from 8.1 to 17.7 mm. The corresponding means were  $13.04 \pm 1.69$  mm on the right and  $12.99 \pm 1.67$  mm on the left. The mean right-left difference was 0.05 mm and this difference was not statistically significant ( $p = 0.700$ ). The overall mean distance between the GPF and the alveolar crest was  $12.42 \pm 3.37$  mm, with measurements ranging from 4.1 to 22.4 mm. The mean distance was  $12.12 \pm 3.47$  mm on the right side and  $12.71 \pm 3.27$  mm on the left side. The right-side measurement was an average of 0.58 mm lower than the left-side measurement. This bilateral difference was statistically significant ( $p = 0.009$ ), with a 95% confidence interval of  $-1.02$  to  $-0.15$  mm. The overall mean canal emergence angle was  $123.69 \pm 8.23^\circ$ , ranging from  $105.9^\circ$  to  $151.1^\circ$ . The mean angles were  $123.66 \pm 7.66^\circ$  on the right and  $123.71 \pm 8.82^\circ$  on the left. The mean paired difference was  $-0.05^\circ$ , with no statistically significant difference between sides ( $p = 0.956$ ).

Table 3 compares the mean bilateral GPF measurements of male and female patients. The mean GPF midline distance was  $13.13 \pm 1.71$  mm among males and  $12.94 \pm 1.51$  mm among females. The mean difference between the groups was 0.19 mm and was not statistically significant ( $p = 0.619$ ). The mean GPF-alveolar crest distance was  $13.28 \pm 2.82$  mm in males and  $11.77 \pm 3.42$  mm in females. The male mean was 1.51 mm higher than the female mean. The difference approached but did not reach statistical significance ( $p = 0.053$ ). The mean canal emergence angle was  $124.16 \pm 7.49^\circ$  among males and  $123.34 \pm 7.11^\circ$  among females. The mean difference was  $0.82^\circ$ , with no statistically significant gender difference ( $p = 0.642$ ).

Table 4 compares the bilateral mean GPF measurements between patients aged 18-49 years and those aged  $\geq 50$  years. The mean GPF-midline distance was  $12.64 \pm 1.37$  mm in the younger group and  $13.37 \pm 1.72$  mm in the older group. The younger group had a mean distance 0.73 mm lower than the older group; however, the difference was not statistically significant ( $p = 0.054$ ). The mean GPF-alveolar crest distance was  $13.22 \pm 3.20$  mm among patients aged 18-49 years and  $11.66 \pm 3.14$  mm among patients aged  $\geq 50$  years.

Table 1: Demographic Characteristics of the Study Participants

| Characteristic      | Category            | n  | %     |
|---------------------|---------------------|----|-------|
| Gender              | Male                | 30 | 42.9  |
|                     | Female              | 40 | 57.1  |
| Age group           | 18-49 years         | 34 | 48.6  |
|                     | ≥50 years           | 36 | 51.4  |
| Gender by age group | Male, 18-49 years   | 15 | 21.4  |
|                     | Male, ≥50 years     | 15 | 21.4  |
|                     | Female, 18-49 years | 19 | 27.1  |
|                     | Female, ≥50 years   | 21 | 30.0  |
| Total               |                     | 70 | 100.0 |

Table 2: Overall and Side-Specific CBCT Measurements of the Greater Palatine Foramen

| Measurement                      | Overall, mean±SD | Range       | Right side, mean±SD | Left side, mean±SD | Mean paired difference (right – left) | 95% CI of difference | p-value |
|----------------------------------|------------------|-------------|---------------------|--------------------|---------------------------------------|----------------------|---------|
| GPF-midline distance (mm)        | 13.02±1.68       | 8.1-17.7    | 13.04±1.69          | 12.99±1.67         | 0.05                                  | –0.21 to 0.31        | 0.700   |
| GPF-alveolar crest distance (mm) | 12.42±3.37       | 4.1-22.4    | 12.12±3.47          | 12.71±3.27         | –0.58                                 | –1.02 to –0.15       | 0.009   |
| Canal emergence angle (degrees)  | 123.69±8.23      | 105.9-151.1 | 123.66±7.66         | 123.71±8.82        | –0.05                                 | –1.96 to 1.85        | 0.956   |

Paired-samples t-test was used to compare the right and left sides. SD: Standard Deviation; CI: Confidence Interval; GPF: Greater Palatine Foramen

Table 3: Comparison of Bilateral mean GPF Measurements according to Gender

| Measurement                      | Male (n = 30), mean±SD | Female (n = 40), mean±SD | Mean difference (male-female) | p-value |
|----------------------------------|------------------------|--------------------------|-------------------------------|---------|
| GPF-midline distance (mm)        | 13.13±1.71             | 12.94±1.51               | 0.19                          | 0.619   |
| GPF-alveolar crest distance (mm) | 13.28±2.82             | 11.77±3.42               | 1.51                          | 0.053   |
| Canal emergence angle (degrees)  | 124.16±7.49            | 123.34±7.11              | 0.82                          | 0.642   |

Measurements represent the mean of the right and left sides for each patient. Independent-samples t-test was used

Table 4: Comparison of Bilateral mean GPF Measurements according to Age Group

| Measurement                      | 18-49 years (n = 34), mean±SD | ≥50 years (n = 36), mean±SD | Mean difference (18-49 – ≥50) | p-value |
|----------------------------------|-------------------------------|-----------------------------|-------------------------------|---------|
| GPF-midline distance (mm)        | 12.64±1.37                    | 13.37±1.72                  | –0.73                         | 0.054   |
| GPF-alveolar crest distance (mm) | 13.22±3.20                    | 11.66±3.14                  | 1.56                          | 0.043   |
| Canal emergence angle (degrees)  | 122.91±7.42                   | 124.42±7.08                 | –1.52                         | 0.384   |

Measurements represent the mean of the right and left sides for each patient. Independent-samples t-test was used

Table 5: Correlations among the Bilateral Mean GPF Measurements

| Variables                                             | Pearson's r | p-value |
|-------------------------------------------------------|-------------|---------|
| GPF-midline distance and GPF-alveolar crest distance  | –0.102      | 0.399   |
| GPF-midline distance and canal emergence angle        | 0.138       | 0.256   |
| GPF-alveolar crest distance and canal emergence angle | 0.087       | 0.472   |

Correlations were calculated using the bilateral mean measurement of each patient

The younger group had a mean distance 1.56 mm greater than the older group. This difference was statistically significant ( $p = 0.043$ ). The mean canal emergence angles were  $122.91 \pm 7.42^\circ$  and  $124.42 \pm 7.08^\circ$  in the younger and older groups, respectively. The mean angle was  $1.52^\circ$  lower in the younger group, but the difference was not statistically significant ( $p = 0.384$ ).

Table 5 presents the correlations among the three GPF measurements. The GPF-midline distance demonstrated a weak negative correlation with the GPF-alveolar crest distance ( $r = -0.102$ ), which was not statistically significant ( $p = 0.399$ ). A weak positive correlation was observed between the GPF-midline distance and canal emergence angle ( $r = 0.138$ ), but this relationship was also not statistically significant ( $p = 0.256$ ). The correlation between the GPF-alveolar crest distance and canal emergence angle was weak and positive ( $r = 0.087$ ) and did not reach statistical significance ( $p = 0.472$ ).

## DISCUSSION

The current study used CBCT images from 70 patients, representing 140 bilateral foramina, to assess the anatomical relationships of the Greater Palatine Foramen (GPF) and greater palatine canal. The midpalatal suture and the GPF were separated by an average of  $13.02 \pm 1.68$  mm. There was no discernible bilateral difference between the mean distances, which were 13.04 mm on the right and 12.99 mm on the left. This suggests that the mediolateral placement of the GPF in the population under study has a high degree of symmetry.

The current study's mean value was lower than that of Ikuta *et al.* [7], who assessed 100 foramina in Brazilian individuals and found that the mean GPF-to-midline maxillary suture distance was  $15.2 \pm 1.45$  mm. The bilateral symmetry found in this study is consistent with Ikuta *et al.*'s conclusion that there was no discernible difference between the left and right sides. However, variations in patient selection, population-related craniofacial variance, or variations in the exact sites utilized to define the center or medial boundary of the foramen could all account for the roughly 2.2-mm discrepancy in mean measures.

In a Lebanese population, Aoun *et al.* [8] found mean GPF-to-midline lengths of  $16.23 \pm 2.29$  mm on the right side and  $14.91 \pm 1.95$  mm on the left. Both values exceeded those found in the current investigation. Furthermore, with an average bilateral difference of 1.32 mm, Aoun *et al.* [8] found that the right GPF was substantially farther from the midline than the left GPF.

This is in contrast to the current study, where the difference between the right and left was only 0.05 mm and not statistically significant. These disparate results could be explained by variations in sample makeup, measuring techniques, palatal width and ethnic origin.

In a Portuguese population, Martins *et al.* [9] found an overall mean GPF-to-midline maxillary suture distance of 14.74 mm. Additionally, this value was higher than the 13.02 mm discovered in the current investigation. However, for every characteristic examined, Martins *et al.* [9] found no discernible difference between the left and right sides. The bilateral symmetry of the GPF-to-midline distance seen in the current sample is thus supported by their findings.

Similarly, Alqahtani *et al.* [10] found that among Saudi adults, the mean GPF-to-midline maxillary suture distance was  $15.25 \pm 1.26$  mm. This was around 2.23 mm higher than the current study's mean. The current Iraqi sample had a lower mean of 13.02 mm, while the Brazilian, Lebanese, Portuguese and Saudi investigations together found GPF-to-midline lengths between roughly 14.7 and 16.2 mm. This implies that rather than relying on a single universal measurement, population-specific anatomical reference values may be crucial when determining the GPF.

With a broad range of 4.1–22.4 mm, the average distance between the GPF and the alveolar crest was  $12.42 \pm 3.37$  mm. Significant variance among patients is indicated by the wide range and comparatively substantial standard deviation. The spatial relationship between the GPF and residual alveolar crest is not consistent, hence this variance may be important when assessing the posterior denture-bearing area.

A mean GPF-to-alveolar ridge distance of  $7.9 \pm 2.04$  mm was reported by Ikuta *et al.* [7], which was significantly less than the current study's mean of 12.42 mm. The populations studied and the definition of the alveolar landmark could be the cause of the discrepancy. Ikuta *et al.* [7] examined the distance between the alveolar ridge and the medial wall of the GPF in patients with completely erupted maxillary first, second and third molars. On the other hand, the current investigation determined the shortest path between the alveolar crest and the GPF center. As a result, variations in dental condition, ridge shape, CBCT orientation and the chosen measurement points may yield disparate outcomes.

Additionally, the current study discovered that the left side had a much larger GPF-to-alveolar crest distance than the right. The left and right mean distances were  $12.71 \pm 3.27$  mm and  $12.12 \pm 3.47$  mm, respectively, resulting in a mean paired difference of 0.58 mm. According to Ikuta *et al.* [7], there was no discernible bilateral variation in their measurements. Therefore, even though the absolute difference was tiny in comparison to the overall variability among individuals, the current study shows a mild directional asymmetry in the interaction between the GPF and alveolar crest.

The greater palatine canal's emergence angle ranged from  $105.9^\circ$  to  $151.1^\circ$ , with an overall mean of  $123.69 \pm 8.23^\circ$ . At  $123.66^\circ$  and  $123.71^\circ$ , respectively, the mean angles on the right and left sides were almost the same. There was no statistically significant side difference found and the mean bilateral difference was barely  $0.05^\circ$ . Despite the noted individual diversity, this shows a significant degree of bilateral similarity in the canal emergence angle.

Rather than measuring the angle between the long axis of the greater palatine canal and the plane of the hard palate, the attached studies typically assessed canal length, dimensions, direction, or curvature. As a result, the current result cannot be directly compared to their angle values. The greater palatine canal's length, upper and lower entrance diameters and curvature were assessed by Pawar *et al.* [11]. They found that canal morphology varied by age and sex and that bent canals were prevalent. Their results corroborate the existence of individual diversity in canal structure, as the current study's comparatively large emergence-angle range suggests.

Alshehri *et al.* [12] reported that 56.2% of the examined canal pathways were curved, while 43.8% were linear. They found no significant difference in curvature distribution between the right and left sides. This agrees generally with the lack of significant right-left variation in the canal emergence angle observed in the present study. Nevertheless, canal curvature and emergence angle represent different anatomical characteristics and should not be considered interchangeable.

Age was significantly correlated with the GPF-to-alveolar crest distance. The mean distance was  $13.22 \pm 3.20$  mm for patients between the ages of 18 and 49 and  $11.66 \pm 3.14$  mm for those 50 years and over. As a result, the older age group's distance was roughly 1.56 mm shorter. This could be the result of cumulative changes after tooth loss or age-related variations in the morphology of the alveolar crest. However, the precise cause of the observed difference cannot be determined because the study was cross-sectional and the length of edentulism was not documented.

According to Pawar *et al.* [11], there were age-related differences in a number of greater palatine canal features. They found that participants between the ages of 18 and 25 had considerably longer average and right canals than those over the age of 25. Additionally, they discovered that the older group's left and average upper-opening diameters were noticeably greater. Both studies show that aging may be linked to changes in the dimensions of the greater palatine area, even though these variables are different from the GPF-to-alveolar crest distance evaluated in the current study.

According to Alshehri *et al.* [12], the distance between the GPF and anterior nasal spine rose by roughly 0.67 mm per ten years, while the PPF-GPC route length reduced by about 0.38 mm. They also noted that the likelihood of a straight canal somewhat increased with age. Although the degree and direction of change vary depending on the specific landmark or canal characteristic under investigation, our results confirm the existence of age-related anatomical variation.

When designing maxillary complete dentures, the large difference in the GPF-to-alveolar crest distance may be important. The greater palatine neurovascular bundle may be impacted by pressure from the denture base when the GPF is situated in close proximity to the residual ridge or functional denture-bearing area. Therefore, a personal evaluation of the posterior palate architecture may be useful in identifying regions that require selective relief or careful contouring.

In a systematic review of 26 studies involving 5,768 hemipalates, Tavelli *et al.* [13] found significant variation in the GPF's position and the greater palatine artery's course. They asserted that the distance between the maxillary teeth and the greater palatine artery varied over the palate and that the GPF was most commonly found in the area of the maxillary third tooth. Their results highlight the fact that each patient's greater palatine neurovascular systems have a different path. The identified anatomical diversity is pertinent for evaluating pressure-sensitive structures beneath a maxillary denture base, even though their work concentrated on palatal soft-tissue transplant harvesting.

There are a number of limitations to this study. Because study was retrospective and only comprised scans from one center, the results might not be as applicable to all Iraqis. The sample size was modest, especially once the patients were split up by age and gender. The dataset does not include precise age, dental status, length of edentulism, level of ridge resorption, palatal shape, or the existence of complete dentures. These variables could affect how the GPF and alveolar crest are related. The identification of the measurement landmarks, reconstruction orientation and image resolution may have had an impact on the measurements, which were based on CBCT images. Furthermore, the examiner was not blinded to patient's age and gender and the study evaluated anatomical measurements rather than clinical outcomes, making it impossible to ascertain whether the observed alterations were related to ulceration, denture pain, instability, or the need for relief. Larger multicenter samples, comprehensive data on edentulous status and ridge-resorption severity, an evaluation of observer reliability and correlations between CBCT anatomy and clinical complete-denture outcomes should also be included in future research.

## CONCLUSION

The greater palatine foramen's physical proximity to the midpalatal suture and alveolar crest, as well as the greater palatine canal's emergence angle, showed significant individual variation in this CBCT-based investigation. The GPF-to-alveolar crest distance was significantly smaller in patients aged  $\geq 50$  years than in those aged 18-49 years and it was significantly larger on the left side than on the right. On the other hand, bilateral symmetry was seen in the GPF-to-midpalatal suture distance and canal emergence angle. There were no discernible relationships or gender differences between the three anatomical parameters. In order to support proper denture-base contouring and reduce pressure over the greater palatine neurovascular region, these findings emphasize the significance of specific assessment of the posterior palatal anatomy when building maxillary complete dentures, especially in older patients.

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