PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 09 (September 2025)

Original Article

OPEN ACCESS

Alveolar Bone Dimensions in Orthodontic Unilateral Impacted Canine Cases using Cone Beam Computed Tomography

Eesha Muneeb[1*], Anum Raza[2], Muhammad Hadeer Rabbani[3], Muhammad Azeem[4], Lailah Ateeq[1] and Faryal Younis[4]

[1]Department of Orthodontics, Rahbar College of Dentistry, Lahore, Pakistan
[2]Department of Orthodontics, Combined Military Hospital Medical College, Lahore, Pakistan
[3]Department of Orthodontics, Lahore Medical and Dental College, Lahore, Pakistan
[4]Department of Orthodontics, De 'Montmorency College of Dentistry, Lahore, Pakistan

ARTICLE INFO

Keywords:
Alveolar Bone, Orthodontic, Cone Beam Computed Tomography Imaging, Impaction

How to Cite:
Muneeb, E., Raza, A., Rabbani, M. H., Azeem, M., Ateeq, L., & Younis, F. (2025). Alveolar Bone Dimensions in Orthodontic Unilateral Impacted Canine Cases using Cone Beam Computed Tomography: Orthodontic Unilateral Impacted Canine Cases using CBCT. Pakistan Journal of Health Sciences, 6(9), 64-69. https://doi.org/10.54393/pjhs.v6i9.3001

***Corresponding Author:**
Eesha Muneeb
Department of Orthodontics, Rahbar College of Dentistry, Lahore, Pakistan
eeshamuneeb94@gmail.com

Received Date: 24th March, 2025
Revised Date: 17th September, 2025
Acceptance Date: 22nd September, 2025
Published Date: 30th September, 2025

ABSTRACT

Impacted canines are due to missing laterals, crowding, or genetics. The alveolar bone that acts as a shock absorber distributes the masticatory forces to the underlying tissues. **Objectives:** To study the mean alveolar bone dimensions on the impaction and non-impaction side of Orthodontic unilateral impacted canine cases using CBCT. **Methods:** This descriptive cross-sectional research was organized at the Department of Orthodontics, CMH Lahore Medical College, where 165 patients were enrolled as per the selection criteria. Bucco-palatal width of the alveolar bone was measured at the level of the alveolar crest, while alveolar bone height was calculated from the alveolar crest to the nasal floor, on the impacted side. These were compared with corresponding alveolar bone dimensions on the non-impaction side, and the values were recorded. An independent samples t-test was used to find out whether any significant difference was present, and post-stratification. A p-value<0.05 was considered significant. **Results:** The mean age of the patients was 34.99 ± 14.69 years. There were 77 (46.7%) male and 88 (53.3%) female. On the impacted side, the mean width of alveolar bone was 6.58 ± 0.67 mm, and the mean height was 17.28 ± 0.67 mm. On the non-impacted side, the mean width and height of alveolar bone were 8.40 ± 0.96 mm and 19.01 ± 0.96 mm, respectively (p=0.001). **Conclusions:** The mean width and height of the alveolar bone on the impacted canine side were lower than the respective alveolar bone dimensions on the non-impacted side.

INTRODUCTION

Maxillary permanent canines are located at the angle of the mouth. They have a major role in maintaining the harmony and symmetry of occlusal relationships and facial aesthetics. Canines not only support facial muscles and lips but also have an important role, acting as guideposts in occlusion. The increased overbite of canines relieves premolars and molars from the exaggerated and adverse masticatory forces that occur during lateral excursive movements of the mandible [1]. Canine impaction is reported to occur in 3.5% of the population [2]. They are the second most commonly impacted teeth after wisdom teeth and are found twice as frequently in female as in male (2:1). Palatal canine impactions are two to three times more prevalent compared to buccal impactions (3:1) [3]. The most common reason for buccal canine impactions is a narrow maxillary arch or insufficient space. Whereas the genetic and guidance theories are the primary two hypothesis that have been put forth to explain the etiology of palatally displaced canines. According to the genetic theory, the primary cause of palatal canine impactions is

DOI: https://doi.org/10.54393/pjhs.v6i9.3001

genetic in origin. Guidance theory states that the root of the lateral incisors serves as a guide, and the canines emerge along its roots. Canine impaction may occur when the lateral incisor root is missing or malformed [4, 5]. Canine impactions may result in complications, including external or internal root resorption of the impacted and adjacent teeth [6], cyst formation, pain, infection, malpositioning of adjacent teeth resulting in loss of arch perimeter [3, 5], and reduction of alveolar bone dimensions [7, 8]. The alveolar bone provides anchorage to Sharpey's fibers, serving as shock absorbers, thus distributing the forces of mastication to the underlying tissues. Alveolar bone also supports the lips and skin around the mouth. Therefore, loss of alveolar bone may result in wrinkling of skin and lips around the mouth and loosening of adjacent and opposing teeth. Loss of alveolar bone is much more critical than apical root resorption for the remaining area of periodontal support. During the initial stages of root resorption and alveolar bone loss, 3mm apical root resorption is equivalent to 1mm crestal bone loss. Following bone loss of more than 2mm, 1mm of crestal bone loss is equivalent to 2mm of apical root resorption [9]. The center of resistance of teeth is also altered after bone loss, thus altering the forces required for the orthodontic movement. Thus, it is very important to make a timely diagnosis and treatment plan for canine impactions to prevent any irreversible harm to the involved teeth and the adjacent teeth. Diagnosis of impacted teeth can be confirmed via panoramic or periapical radiographs, but these techniques have their own shortcomings as they represent a 2-dimensional image of a 3-dimensional object. In addition to that, palatally displaced canines are often situated at the most curved part of the palate. Thus, it is difficult to avoid any distortion in radiographs in this area. To overcome these limitations, dentists have started using CBCT as it not only shows a 3-dimensional image of the impacted tooth and its precise location, but also the status of roots of adjacent teeth and the dimensions of alveolar bone [10]. According to a study conducted by Aditya Tadinada [8], the bucco-palatal width on the impacted side was 6.87 ± 1.08 mm, while on the non-impacted side, it was 8.70 ± 1.13mm. Alveolar bone height was 18.12 ± 2.28 mm and 19.49 ± 2.8 mm on the impacted and non-impacted side, respectively. This study has not been done in the Pakistani population in recent years. This study helps orthodontists in planning multidisciplinary treatment of impacted canines, improve arch symmetry, and prevent irreversible damage to impacted teeth, as well as neighboring teeth and alveolar bone.

This study aims to measure the dimensions of the alveolar bone both in vertical and horizontal directions on the impaction and non-impaction side of the same patient using CBCT.

METHODS

This descriptive cross-sectional research was undertaken for six months, spanning from January 2022 to June 2022. The research protocol was approved by the Ethical Review Committee of the Institute of Dentistry, CMH Lahore Medical College (Case#.441/ERC/CMH/LMC). Participants provided informed consent to participate in this study. A total of 165 CBCT scans of patients with unilateral maxillary canine impactions, who were willing to undergo comprehensive orthodontic treatment, were evaluated. The sampling technique was a non-probability, consecutive sampling type. Sample size was calculated by the Open Epi sample size calculator, taking the mean alveolar bone height on the impacted side as 18.12 ± 2.38 mm [8], mean alveolar bone height on the non-impacted side as 19.49 ± 2.09 mm [8] and power of test as 80%. The calculated sample size was 84 (42 in each) at 95% confidence interval. To compensate for potential dropouts or image exclusions due to quality issues, the sample size was increased to 165. Impaction was characterized when the tooth failed to erupt after complete root formation or when the contralateral canine was fully erupted. Inclusion criteria were: 1-Patient with a palatally impacted canine in which the deciduous maxillary canine is not retained on the side of the canine impaction. 2- Full eruption of the canine on the other side. 3- No previous orthodontic treatment. 4- Patients 12-60 years old, both genders. Exclusion criteria involved: 1- CBCT scans showing any pathology. 2- Any systemic bone disease. 3- Craniofacial syndromes. The CBCT images were taken from a Promax 3D CBCT machine (Planmeca, Finland) with Romexis software. The CBCT scans were taken with orthodontic patients in the upright position, with the Frankfort horizontal plane parallel to the floor in maximum interdigitation. For the analysis of canine impaction cases, the CBCT images were saved as digital imaging and communications in medicine (DICOM) using Planmeca Romexis viewer 4.6.0.R CBCT software. Bucco-palatal width and height of alveolar bone were measured on the impaction side, and it was compared with alveolar bone dimensions on the non-impaction side. The first step involved panoramic reconstruction from CBCT. Then, two reference lines were drawn to orient researchers and calibrate measurements. The reference line A was drawn tangent to the crest of the alveolar bone in the panoramic reconstruction retrieved from the CBCT scan. The Reference line B was drawn perpendicular to reference line A, representing the ideal location of the long axis of the canine. The height of the alveolar bone was recorded as a distance from the nasal floor to the alveolar crest (reference line A). Alveolar Bone Width was recorded as the bucco-palatal distance of the alveolar crest, in millimetres, on a scale provided by CBCT.

DOI: https://doi.org/10.54393/pjhs.v6i9.3001

To minimize measurement bias, reference line A (tangent to the alveolar crest) was standardized by visually identifying the consistently highest points of the crest (buccal and palatal) in the region of interest and drawing the line precisely tangent to them. Reference line B (perpendicular to A, representing ideal canine axis) was standardized by drawing it perpendicular (90 degrees using software tools) to reference line A, forming a consistent anatomical reference point (estimated center of the alveolar crest) within the impacted canine's expected position. The Planmeca Romexis software's calibrated scale was used for direct measurements, with reference lines guiding consistent measurement locations. This systematic approach aimed to ensure reliable and valid comparisons across all CBCT scans. Data analysis was performed by IBM SPSS Statistics version 27.0. Normality was checked by the Kolmogorov-Smirnov test. Mean ± standard deviation and median (1st quartile-3rd quartile) were presented for quantitative variables. Frequency and percentages were reported for qualitative variables. Since the data were not normally distributed, the independent sample t-test was not applicable. We utilized its non-parametric alternative. Hence, comparison of quantitative variables was done by the Mann-Whitney U test and the Wilcoxon signed-rank as appropriate. The p-values≤0.05 were considered significant.

RESULTS

The current study included 165 patients, of whom 53.3% were female. The median age of patients was 33(22-47) years, ranging from 12 years to 60 years. There were 72.7% of patients aged up to 45 years and 27.3% over 45 years. Among 165 patients, the left side was involved in 52.7% and the right side in 47.3% of patients. Whereas 47.3% were found with buccal and 52.7% with palatal sites. Detailed descriptive statistics of patient demographics and side and site are in table 1.

Table 1: Demographic and Clinical Profile of Study Participants (n=165)

Variables	Frequency (%)
Gender	
Male	77 (46.7%)
Female	88 (53.3%)
Age (Years)	
Median(Q1-Q3)	33 (22-47%)
Age Group	
≤45 Years	120 (72.7%)
>45 Years	45 (27.3%)
Site	
Buccal	78 (47.3%)
Palatal	87 (52.7%)

The median alveolar bone width at the impacted and non-impacted sides was 6.60 (6.00-7.20) mm and 8.40 (7.60-9.20) mm, respectively, while the median alveolar bone height at the impacted and non-impacted sides was 17.30 (16.70-17.90) mm and 19.00 (18.20-19.80), as shown in Table 2 (Figures 1 and 2).

Table 2: Descriptive Statistics for Alveolar Bone Width and Height

Variables	Min to Max	Mean ± SD	Median (Q1-Q3)
Alveolar Bone Width-Impacted Side (mm)	5.5 to 7.7	6.58 ± 0.67	6.60 (6.00-7.20)
Alveolar Bone Height-Impacted Side (mm)	16.2 to 18.4	17.28 ± 0.67	17.30 (16.70-17.90)
Alveolar Bone Width-Non Impacted Side (mm)	6.8 to 10.1	8.41 ± 0.96	8.40 (7.60-9.20)
Alveolar Bone Height Non Impacted Side (mm)	17.4 to 20.7	19.01 ± 0.96	19.00 (18.20-19.80)

Study discovered a significant difference in alveolar bone width-impacted side by gender (p=0.045). The findings provide a detailed comparison of alveolar bone width and height on the impacted and non-impacted sides (Table 3).

Table 3: Comparison of Alveolar Bone Width in Impacted and Non-Impacted Sides

Variables	Alveolar Bone Width (mm) Impacted Side			Alveolar Bone Width (mm) Non-Impacted Side		
	Mean ± SD	Median (Q1-Q3)	p-Value	Mean ± SD	Median (Q1-Q3)	p-Value
Gender						
Male	6.68 ± 0.63	6.70 (6.20-7.20)	0.045*	8.45 ± 0.97	8.50 (7.60-9.30)	0.543
Female	6.74 ± 0.69	6.40 (5.90-7.07)		8.36 ± 0.96	8.30 (7.50-9.17)	
Age Group						
≤45 Years	6.47 ± 0.64	6.40 (5.90-7.00)	0.572	8.47 ± 1.05	8.65 (7.42-9.40)	0.090
>45 Years	6.85 ± 0.67	7.00 (6.55-7.40)		8.21 ± 0.64	8.10 (7.80-8.60)	
Buccal	6.60 ± 0.70	6.60 (5.97-7.30)	0.001*	8.27 ± 1.01	8.05 (7.40-9.20)	0.120
Palatal	6.55 ± 0.64	6.50 (6.00-7.10)		8.52 ± 0.90	8.60 (7.80-9.30)	

The study also found a significant difference in alveolar bone height on the impacted side by gender (p=0.045). The findings provide a detailed comparison of alveolar bone width and height on the impacted and non-impacted sides (Table 4).

DOI: https://doi.org/10.54393/pjhs.v6i9.3001

Table 4: Comparison of Alveolar Bone Height in Impacted and Non-Impacted Sides

Variables	Alveolar Bone Height Impacted Side			Alveolar Bone Height Non-Impacted Side		
	Mean ± SD	Median (IQR)	p-Value	Mean ± SD	Median (IQR)	p-Value
Gender						
Male	17.38 ± 0.63	17.40 (16.90-17.90)	0.045*	19.05 ± 0.97	19.10 (18.20-19.90)	0.543
Female	17.17±0.69	17.10 (16.60-17.77)		18.96 ± 0.96	18.90 (18.10-19.77)	
Age Group						
≤45 Years	17.17 ± 0.64	17.10 (16.60-17.70)	0.572	19.07 ± 1.05	19.25 (18.02-20.00)	0.090
>45 Years	17.55 ± 0.67	17.70 (17.25-18.10)		18.81 ± 0.64	18.70 (18.40-19.20)	

The Mann-Whitney U test was applied. p-value≤0.05 is considered significant. *Significant at 0.05 levels

Further findings show substantial differences in alveolar bone width and height between impacted and non-impacted sides (p<0.001) (Table 5).

Table 5: Comparison of Alveolar Bone Width and Height According to the Impacted and Non-Impacted Side

Variables	Mean ± SD	Median (Q1-Q3)	p-Value
Alveolar Bone Width-Impacted Side	6.58 ± 0.67	6.60 (6.00-7.20)	<0.001*
Alveolar Bone Width-Non-impacted Side	8.41 ± 0.96	8.40 (7.60-9.20)	
Alveolar Bone Height-Impacted Side	17.28 ± 0.67	17.30 (16.70-17.90)	<0.001*
Alveolar Bone Height-Non-impacted Side	19.01 ± 0.96	19.00 (18.20-19.80)	

The Wilcoxon signed-rank test was applied. p-value≤0.05 is considered as significant. *Significant at 0.05 levels

DISCUSSIONS

Canines are regarded as key elements of the upper and lower dental arches due to their vital role in establishing precise occlusion. However, canine impaction can affect the height and width of the alveolar bone, as the alveolar process develops in response to tooth eruption. Consequently, any deviation from normal tooth development and eruption necessitates careful examination [11]. Therefore, it is of crucial importance that timely diagnosis and treatment of impacted canines is made to avoid irreversible injury to the canine itself and its adjacent teeth. The purpose of our study was to examine the height and width of the alveolar bone on the affected and non-affected sides to understand the mechanical environment. This study helps orthodontists to plan and formulate a treatment plan that is minimally invasive and of decreased cost and treatment time. Timely intervention also decreases the psychological trauma to the patient. As CBCT has already been acknowledged as accurate in determining certain parameters, so it was used to investigate unilaterally impacted canine cases, whether buccal or palatal. CBCT investigations were also done to measure skeletal and dento-alveolar parameters of the maxilla [12]. The diagnostic technique preferred for the identification of tooth impaction is CBCT [13]. In comparison to any two-dimensional radiograph, it eliminates errors resulting from overlapping of structures, superimpositions, and blurring of images. Hence, we selected CBCT as the favored system for the evaluation of bone height and width due to its accuracy in assessing bone morphology and structure [14, 15]. Few studies were performed with the same approach, but they did not contain all the variables as in this study. According to our study, the alveolar bone dimensions were reduced on the impaction side with a mean width of alveolar bone of 6.58 ± 0.67 mm and a mean height of 17.28 ± 0.67mm. Whereas, the mean width of alveolar bone was measured 8.40 ± 0.96 mm, and the mean height was 19.01 ± 0.96 mm on the non-impacted side. Our research also revealed that unilateral impactions are more commonly found in female and are found more prevalent on the left side of the maxillary arch. These findings are consistent with those reported by other studies [16]. According to the results of a research by Elhamshary *et al.*, the basal maxillary width in the control group was 63.63 ± 4.60mm, whereas in the unilaterally impacted canine group, the results showed decreased width with a value of 62.04 ± 3.38mm [17]. These results are similar to those found by Sadrhaghighi *et al.*, in which alveolar thickness was less on the impacted side than on the non-impacted side when measured at 2mm height. Maxillary arch width was also significantly reduced on the impacted side [7]. Our study also demonstrated similar findings, revealing reduced alveolar bone dimensions on the impacted side compared to the non-impacted side. Another study by Sharhan *et al.*, showed that both maxillary unilateral and bilateral canine impaction are associated with decreased maxillary dimension except arch depth [6]. A study done by Sar *et al.*, on basal lateral width, inter-premolar width, and angulation of canines. They found that the mean basal lateral width of the impacted side was significantly reduced (p<0.05). On the impacted side, the inter-premolar width was similarly significantly decreased (p<0.05) [18]. More studies also had similar results to our research. A study done by Montes-Díaz *et al.*, on unilateral impacted canines showed smaller angular and linear dento-skeletal measurements on the affected side in comparison to the non-affected side [19]. A study by Arvind *et al.*, showed increased BMSA (Bone marrow surface area)

DOI: https://doi.org/10.54393/pjhs.v6i9.3001

in female, showing lesser bone density in female as compared to males. Whereas, BSA (Bone surface area) showed no gender variability. Dense alveolar bone microstructure was appreciated around impacted canines when compared to the non-impacted side, in contrast to completely erupted canines [20]. An advantage of the present study over previous ones is that it addressed a greater number of variables and also explored gender associations. The results of the normality test in the analysis showed normal distribution for their population; however, a limitation of the study was a smaller sample size. Our study also showed a gender association, similar to this study. A significant gender wise difference was found. This might be due to a larger number of participants as compared to Arvind TR et al. study. Based on this study's results, early detection and treatment of impacted canines allow alveolar bone to develop properly. It also allows orthodontists to carry out tooth movement more efficiently, producing more aesthetic and efficient results. The positive and negative variation of results as compared to other studies might be due to changes in the research protocols. The sample in our study was collected from a single-center setting. The sample size was larger than that of other studies but was still within a moderate range. So it is suggested that in the future, further studies should be done with improved methodology.

CONCLUSIONS

CBCT imaging shows that the mean width and height of alveolar bone on the impacted canine side were lower than the respective alveolar bone dimensions on the non-impacted side.

Authors Contribution

Conceptualization: EM
Methodology: EM, AR, MHR, MA, LA
Formal analysis: EM
Writing review and editing: EM, AR, MHR, MA, LA, FY

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

REFERENCES

[1] Momeni Danaie S, Salehi P, Kalantary MH. The Importance of Maxillary Canine: A Review. Journal of Dentistry. 2019 Jan; 4(3): 53-61.

[2] Kiran S, Nazir A, Khaliq F, Zahid Mr, Fayyaz A, Alishbah A. Frequency, Causes and Pattern of Presentation of Impacted Maxillary Canine, A Clinical and Radiographic Study. Pakistan Journal of Medical and Health Sciences. 2023; 17(11): 65-. doi: 10.53350/pjmhs02023171165.

[3] Firincioglulari M, Kurt D, Koral S, Orhan K. Maxillary Canine Impaction: Assessing the Influence of Maxillary Anatomy Using Cone Beam Computed Tomography. Medical Science Monitor: International Medical Journal of Experimental and Clinical Research. 2024 May; 30: e944306-1. doi: 10.12659/MSM.944306.

[4] Papageorgiou SN, Seehra J, Cobourne MT, Kanavakis G. Does Current Evidence Support the Discussion Around the Guidance Theory? A Systematic Review and Meta‐Analysis on the Association Between Maxillary Lateral Incisor Agenesis and Displacement or Impaction of the Permanent Canine. Orthodontics and Craniofacial Research. 2025 Apr; 28(2): 312-23. doi: 10.1111/ocr.12878.

[5] Sathyanarayana HP, Nucci L, d'Apuzzo F, Perillo L, Padmanabhan S, Grassia V. Prevalence, Etiology, Clinical Features and Management Associated with Impacted and Transmigrated Mandibular Canines: A Systematic Review. BioMed Central Oral Health. 2023 Dec; 23(1): 975. doi: 10.1186/s12903-023-03717-1.

[6] Sharhan HM, Almashraqi AA, Al-Fakeh H, Alhashimi N, Abdulghani EA, Chen W *et al.* Qualitative and Quantitative Three-Dimensional Evaluation of Maxillary Basal and Dentoalveolar Dimensions in Patients with and without Maxillary Impacted Canines. Progress in Orthodontics. 2022 Oct; 23(1): 38. doi: 10.1186/s40510-022-00434-3.

[7] Sadrhaghighi AH, Farrokhi S, Rad M, Eskandarinezhad M. Evaluation of the Association of Alveolar Bone Dimensions in Unilateral Palatally Impacted Canine: A Cone-Beam Computed Tomography Analysis. Journal of Orofacial Sciences. 2022 Jan; 14(1): 21-7. doi: 10.4103/jofs.jofs_79_22.

[8] Tadinada A, Mahdian M, Vishwanath M, Allareddy V, Upadhyay M, Yadav S. Evaluation of Alveolar Bone Dimensions in Unilateral Palatally Impacted Canine: A Cone-Beam Computed Tomographic Analyses. European Journal of Orthodontics. 2015 Feb; 37(6): 596-602. doi: 10.1093/ejo/cju098.

[9] Karnati PK, Seth P, Zamzuri AT, Tharwani P. Orthodontically Induced External Apical Root Resorption in Class II Malocclusion. Case Reports in Dentistry. 2021; 2021(1): 8290429. doi: 10.1155/2021/8290429.

[10] Peralta-Mamani M, Rubira CM, López López J, Honório HM, Rubira-Bullen IR. CBCT vs Panoramic Radiography in Assessment of Impacted Upper

DOI: https://doi.org/10.54393/pjhs.v6i9.3001

Canine and Root Resorption of the Adjacent Teeth: A Systematic Review and Meta-Analysis. Journal of Clinical and Experimental Dentistry. 2024 Jan; 16(2): 198-222. doi: 10.4317/jced.61285.

[11] Yassaei S, Safi Y, Valian F, Mohammadi A. Evaluation of Maxillary Arch Width and Palatal Volume and Depth in Patients with Maxillary Impacted Canine by CBCT. Heliyon. 2022 Oct; 8(10). doi: 10.1016/j.heliyon.2022.e10854.

[12] Alhummayani FM and Mustafa ZA. A New Guide Using CBCT to Identify the Severity of Maxillary Canine Impaction and Predict the Best Method of Intervention. Journal of Orthodontic Science. 2021 Jan; 10(1): 3. doi: 10.4103/jos.JOS_41_20.

[13] Grybienė V, Juozėnaitė D, Kubiliūtė K. Diagnostic Methods and Treatment Strategies of Impacted Maxillary Canines: A Literature Review. Stomatologija. 2019 Jan; 21(1): 3-12.

[14] Gudelevičiūtė I, Spaičytė N, Smailienė D. Skeletal and Dental Maxillary Morphological Characteristics in Patients with Impacted Canines: Systematic Review and Meta-Analysis. European Journal of Orthodontics. 2023 Dec; 45(6): 832-41. doi: 10.1093/ejo/cjad050.

[15] Dinu Ş, Todor L, Zetu IN, Păcurar M, Porumb A, Milutinovici RA *et al.* Radiographic Methods for Locating Impacted Maxillary Canines. Romanian Journal of Morphology and Embryology. 2022 Dec; 63(4): 599.

[16] Mucedero M, Rozzi M, Di Fusco G, Danesi C, Cozza P. Morphometric Analysis of the Palatal Shape and Arch Dimension in Subjects with Buccally Displaced Canine. European Journal of Orthodontics. 2020 Oct; 42(5): 544-50. doi: 10.1093/ejo/cjz091.

[17] Elhamshary SA, Refaat WE, Ramadan AA. Maxillary Transverse Dimensions in Subjects with Impacted Canine Compared with Normal Subjects Using Cone Beam Computed Tomography. Dental Science Updates. 2023 Mar; 4(1): 141-7. doi: 10.21608/dsu.2023.148976.1132.

[18] Sar S, Singh M, Sharma A, Sharma P, Raza M. Skeletal and Dentoalveolar Dimensions in Unilateral Impacted Canınes, A Cone Beam Computed Tomography Study. European Oral Research. 2022 May; 56(2): 74-9.

[19] Montes-Díaz ME, Martínez-González A, Arriazu-Navarro R, Alvarado-Lorenzo A, Gallardo-López NE, Ortega-Aranegui R. Skeletal and Dental Morphological Characteristics of the Maxillary in Patients with Impacted Canines Using Cone Beam Computed Tomography: A Retrospective Clinical Study. Journal of Personalized Medicine. 2022 Jan; 12(1): 96. doi: 10.3390/jpm12010096.

[20] Arvind TP, Jain RK, Nagi R, Tiwari A. Evaluation of Alveolar Bone Microstructure Around Impacted Maxillary Canines Using Fractal Analysis in Dravidian Population: A Retrospective CBCT Study. The Journal of Contemporary Dental Practice. 2022 Sep; 23(6): 593-600. doi: 10.5005/jp-journals-10024-3343.