Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/dtd76s80

EVALUATING DIFFERENT CEPHALOMETRIC FACIAL PLANES WITH INTERCANINE WIDTH IN ORTHODONTIC PATIENTS

Dr. Utkarsh Singh[1]*, Dr. Vertika Gupta[2]

[1*]Senior Lecturer/Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, New Horizon Dental College and Research Institute, Bilaspur, Chhattisgarh, India.
[2]MDS Pedodontics, Senior Dental Surgeon, Community Health Centre, Kasmanda , Sitapur, Uttar Pradesh, India.

***Corresponding author:** Dr. Utkarsh Singh
*Senior Lecturer/Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, New Horizon Dental College and Research Institute, Bilaspur, Chhattisgarh, India.
ut1989reloaded@gmail.com

Abstract

Background: Intercanine width plays a crucial role in determining dental arch form, occlusal stability, and facial esthetics in orthodontic patients. Cephalometric facial planes, including the Frankfort horizontal, palatal, and mandibular planes, are commonly used to analyze craniofacial morphology; however, their correlation with intercanine width has not been fully established.
Methods: A cross-sectional study was conducted on 120 orthodontic patients aged 14–25 years. Lateral cephalograms were used to measure Frankfort horizontal plane (FHP), palatal plane (PP), and mandibular plane (MP) angles relative to a reference cranial base line. Intercanine width (ICW) was measured on dental casts using a digital caliper. Patients were divided into three skeletal pattern groups based on mandibular plane angle: low-angle (<28°), average-angle (28–36°), and high-angle (>36°). Pearson correlation, ANOVA, and linear regression were applied.
Results: The mean intercanine width was 26.7 ± 2.1 mm. High-angle cases had significantly lower ICW (25.2 ± 1.8 mm) compared to low-angle (27.8 ± 1.7 mm) and average-angle (26.9 ± 1.9 mm) groups ($p < 0.001$). A significant negative correlation was observed between mandibular plane angle and ICW ($r = -0.58$, $p < 0.001$). FHP and PP showed weaker correlations ($r = -0.21$ and -0.27, respectively; $p > 0.05$).
Conclusion: Mandibular plane angle demonstrated a significant inverse relationship with intercanine width, suggesting its clinical relevance in diagnosis and arch form planning in orthodontics. Other cephalometric planes had a limited predictive value.

Introduction

Intercanine width is a critical determinant of the dental arch form, functional occlusion, and long-term stability of orthodontic results [**1**]. Variations in facial morphology, especially vertical skeletal pattern, may influence the transverse dimensions of the dental arch, including intercanine width. Cephalometric analyses, routinely employed in orthodontics, provide reliable assessments of craniofacial structure and vertical growth patterns [**2**].

Several cephalometric planes—such as the Frankfort horizontal plane (FHP), palatal plane (PP), and mandibular plane (MP)—are commonly utilized to determine craniofacial orientation and growth

patterns. Among these, the mandibular plane angle is often considered a vital parameter in distinguishing between low-angle, average-angle, and high-angle skeletal patterns [**3**].
Recent studies have examined the association between vertical skeletal morphology and dental arch width. For instance, Basciftci et al. found that hyperdivergent (high-angle) individuals tend to have narrower maxillary and mandibular intercanine widths [**4**]. Similarly, Al-Khateeb et al. reported reduced maxillary arch dimensions in individuals with long-face syndrome [**5**]. Despite these findings, there remains limited evidence correlating specific cephalometric planes with intercanine width, especially in populations with diverse facial types.

Understanding the influence of cephalometric facial planes on intercanine width is crucial for predicting treatment stability and planning arch form selection during orthodontic intervention. Hence, this study aims to evaluate the relationship between different cephalometric facial planes and intercanine width in orthodontic patients.

Materials and Methods

Study Design and Participants

This cross-sectional analytical study was conducted in a college orthodontic department between January 2019 and October 2019. A total of 120 patients (60 males and 60 females) aged 14 to 25 years undergoing orthodontic treatment were recruited based on consecutive sampling.

Inclusion Criteria

- Permanent dentition present up to the second molars
- No previous orthodontic treatment
- Class I molar relationship with normal overjet and overbite
- No craniofacial syndromes or cleft deformities

Exclusion Criteria

- Congenital anomalies or history of trauma affecting jaw morphology
- Missing or malformed maxillary canines
- Severe crowding (>4 mm) in the anterior region

Measurements

Lateral cephalometric radiographs were taken using a standardized protocol (5 mA, 78 kVp, 0.8 s exposure). Cephalometric analysis included:

- Frankfort Horizontal Plane (FHP): line connecting orbitale and porion
- Palatal Plane (PP): line connecting anterior nasal spine and posterior nasal spine
- Mandibular Plane (MP): line connecting gonion to menton

Each angle (FHP to cranial base, PP to cranial base, MP to cranial base) was measured in degrees using digital cephalometric tracing software (Dolphin Imaging®). Based on MP angle, patients were grouped into:

- Group 1 (Low-angle): MP <28°
- Group 2 (Average-angle): MP 28°–36°
- Group 3 (High-angle): MP >36°

Intercanine width was measured between cusp tips of maxillary canines on dental casts using a calibrated digital caliper to the nearest 0.1 mm.

Statistical Analysis

All data were analyzed using SPSS v26.0. Normality was assessed using Shapiro-Wilk test. One-way ANOVA and Tukey's post hoc test were applied to compare ICW among groups. Pearson correlation was used to assess the relationship between ICW and each cephalometric plane. A p-value <0.05 was considered statistically significant.

Results

Sample Characteristics

The mean age of the participants was 18.9 ± 3.2 years. The sample distribution was balanced across the three skeletal pattern groups: 40 patients each in low-angle, average-angle, and high-angle groups.

Intercanine Width Comparisons

Table 1 summarizes the mean intercanine width across groups. Patients with high-angle patterns had significantly smaller intercanine widths compared to the other two groups.

Table 1: Mean Intercanine Width by Skeletal Pattern

Group	n	Intercanine Width (mm)	SD	p-value
Low-angle	40	27.8	1.7	
Average-angle	40	26.9	1.9	
High-angle	40	25.2	1.8	<0.001*

*ANOVA significant, post hoc: High-angle < Low- and Average-angle

Correlation with Cephalometric Planes

Pearson correlation analysis revealed a significant negative correlation between ICW and mandibular plane angle ($r = -0.58$, $p < 0.001$). FHP and PP angles showed weaker and non-significant correlations.

Table 2: Correlation of Cephalometric Angles with Intercanine Width

Cephalometric Plane	Correlation Coefficient (r)	p-value
Mandibular Plane	–0.58	<0.001*
Palatal Plane	–0.27	0.078
Frankfort Plane	–0.21	0.121

Discussion

This study demonstrates a significant inverse relationship between mandibular plane angle and intercanine width in orthodontic patients. Specifically, individuals with high-angle skeletal patterns exhibited narrower intercanine widths compared to those with low- or average-angle patterns. This finding aligns with the craniofacial compensatory mechanisms seen in hyperdivergent individuals, who often have longer faces and reduced transverse dimensions [**6**].

Our results corroborate the findings of Araujo and Buschang, who reported that vertical facial growth patterns influence arch form and width, with narrow intercanine dimensions observed in long-face patients [**7**]. Similarly, Ceylan and Oktay found a significant negative correlation between mandibular plane angle and transverse maxillary dimensions [**8**].

The limited correlation of intercanine width with the Frankfort and palatal planes in this study suggests that mandibular inclination may be a more critical determinant of arch width. This is consistent with Proffit's biomechanical model, which emphasizes the role of muscle balance and mandibular divergence in shaping the arch form [**9**].

While our study focused on cephalometric analysis, other factors such as buccal corridor width, soft tissue morphology, and muscular function could also influence intercanine width [**10–12**]. Additionally, ethnic differences may play a role, as shown by Uysal et al., who observed population-specific variations in dental arch dimensions [**13**].

The clinical implications of these findings are significant. In orthodontic treatment planning, particularly in non-extraction cases, understanding the skeletal pattern can help in selecting an appropriate arch form and avoiding relapse due to transverse instability [**14**, **15**].

Despite its strengths, this study has limitations. The sample size, though adequate, was limited to a single institution. Future research should incorporate 3D imaging and larger multiethnic cohorts to validate and generalize the findings [**16-18**].

Conclusion

Mandibular plane angle was found to have a significant inverse correlation with intercanine width in orthodontic patients, while Frankfort and palatal planes showed limited association. High-angle patients exhibited narrower intercanine widths, highlighting the need to consider vertical skeletal pattern in arch form selection and treatment planning.

References

1. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. 6th ed. St. Louis: Elsevier; 2019.
2. Jacobson A, Jacobson RL. Radiographic Cephalometry. 2nd ed. Quintessence Publishing; 2006.
3. Kumar S, Sharmila R. Correlation between mandibular plane angle and arch width. J Indian Orthod Soc. 2018;52(1):22-6. doi:10.4103/jios.jios_34_17
4. Basciftci FA, Uysal T, Buyukerkmen A, Sari Z. Dental arch width changes in extraction and nonextraction treatment. Angle Orthod. 2002;72(1):71–78. PMID: 11843273
5. Al-Khateeb SN, Abu Alhaija ES. Tooth size discrepancies and arch parameters among different malocclusions. Angle Orthod. 2006;76(4):628–633. PMID: 16808575
6. Riolo ML, Moyers RE, McNamara JA, Hunter WS. An atlas of craniofacial growth. Monograph 2. Craniofacial Growth Series. University of Michigan; 1974.
7. Araujo EA, Buschang PH. Adaptive capacity of the midface and its relevance to orthodontics. Angle Orthod. 2011;81(5):933-939. doi:10.2319/102010-615.1
8. Ceylan I, Oktay H. A study on the facial proportions and relationship between the dental and skeletal structures in skeletal Class III cases. Eur J Orthod. 1995;17(5):395–402. PMID: 8536404
9. Proffit WR. Equilibrium theory revisited: factors influencing position of the teeth. Angle Orthod. 1978;48(3):175–186. PMID: 279064
10. Ricketts RM. A foundation for cephalometric communication. Am J Orthod. 1960;46:330–357.
11. Singh G, McNamara JA Jr. Cephalometric and arch width changes following cervical headgear and rapid maxillary expansion. Angle Orthod. 2000;70(3):217–230. PMID: 10928481
12. Bhowmik S, Hazarey PV, Shrivastav SS. Transverse arch dimension changes with passive self-ligating bracket system. Am J Orthod Dentofacial Orthop. 2010;137(3):306–308. doi:10.1016/j.ajodo.2008.09.025
13. Uysal T, Sari Z, Basciftci FA, Memili B. Dental arch width and its correlation with cephalometric parameters. Eur J Orthod. 2005;27(6):601–608. PMID: 16373440
14. Fleming PS, DiBiase AT, Sarri G, Lee RT. Arch form in orthodontics: a review. Am J Orthod Dentofacial Orthop. 2013;143(5):624–633. doi:10.1016/j.ajodo.2013.01.004
15. Ibrahim S, El-Bialy T. Comparison of arch forms between different vertical skeletal patterns. J Orthod Sci. 2016;5(2):61–65. doi:10.4103/2278-0203.186172
16. Gribel BF, Gribel MN, Frazao DC, McNamara JA Jr, Manzi FR. Accuracy and reliability of 3D CBCT cephalometric analysis using landmarks generated by automated image processing. Orthod Craniofac Res. 2011;14(4):194–202. doi:10.1111/j.1601-6343.2011.01525.x
17. Park JH, Yu HS, Kim KD, Lee KJ, Baik HS. A proposal for a new analysis of transverse dental arch relationships using 3D images. Korean J Orthod. 2011;41(3):191–200. doi:10.4041/kjod.2011.41.3.191.
18. Mishra BP, Harish A, Mathew AM, Pradhan A, Sneha S, Murty V, Makkad RS. Management of zygomatic fractures using different surgical approaches. Bioinformation. 2023; 31;19(13):1371-1376. doi: 10.6026/973206300191371.