IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CORRELATION BETWEEN GINGIVAL PHENOTYPE IN THE MAXILLARY ANTERIORS AND VERTICAL FACIAL TYPES AND GENDER USING CONE BEAM COMPUTED TOMOGRAPHY: A PILOT STUDY

Vanshika Chavan, Ajay R Bhoosreddy, Chetan Bhadage, Tejashree D, Rutuja K

PG student, Professor, Head of Department, PG student, PG student

Department of Oral Medicine and Radiology,

MGV KBH Dental College and Hospital City, Nashik India

Abstract:

Background: Gingival phenotype (GP) represents the morphologic characteristics of gingival tissue and underlying bone. It plays a significant role in periodontal stability, orthodontic treatment planning, and implant success. This study evaluated the correlation between gingival phenotype in maxillary anterior teeth and vertical facial types and gender using Cone Beam Computed Tomography (CBCT).

Aim: To assess the association between gingival thickness and vertical facial types and gender.

Materials and Methods: A cross-sectional analytical study was conducted using 30 archived CBCT scans selected through simple random sampling. Gingival thickness and alveolar bone thickness were measured at standardized levels. Skeletal classification was determined using ANB angle. Statistical analysis was performed using SPSS version 21 with significance set at $p < 0.05$.

Results: Comparison of gingival thickness revealed that females exhibited significantly greater values than males at the CEJ and coronal to the bone crest ($p < 0.05$). However, no significant differences were observed at 3 mm and 5 mm apical to the CEJ. Alveolar bone thickness did not differ significantly between sexes at either 3 mm or 5 mm apical to the CEJ ($p > 0.05$). Analysis of facial type distribution showed Type I as the most prevalent in both sexes, followed by Type II and Type III, with no statistically significant sex-related differences ($p = 0.824$).

Conclusion: Gingival phenotype may show correlation with vertical skeletal morphology and gender, which can influence interdisciplinary treatment planning.

Keywords: Gingival phenotype, Cone beam computed tomography, Vertical facial pattern, Gingival thickness, Maxillary anterior teeth, Periodontal biotype

I. INTRODUCTION

Gingival phenotype describes the thickness and morphologic characteristics of the gingiva and supporting alveolar bone. It is commonly classified as thin or thick, each presenting distinct clinical implication. Thick gingival phenotype is generally associated with increased fibrotic tissue, reduced susceptibility to recession, and improved response to surgical and orthodontic procedures, whereas thin phenotype is more prone to attachment loss and esthetic complications.

Craniofacial morphology influences alveolar bone dimensions, tooth inclination, and periodontal support. Vertical skeletal patterns may affect the distribution and thickness of both hard and soft tissues in the anterior maxilla. With the advent of CBCT imaging, three-dimensional evaluation of periodontal structures has become more accurate and reliable.

Despite increasing literature on gingival phenotype and craniofacial morphology independently, limited studies have evaluated their correlation in the maxillary anterior region using CBCT. Therefore, this study aims to bridge this gap.

Materials and Methods:

Study Design: A CBCT-based pilot study.

Sample Size: 30 CBCT scans calculated based on correlation coefficient formula with 5% significance and 80% power.

Inclusion Criteria: High-quality CBCT scans with fully erupted maxillary anterior teeth.

Exclusion Criteria: Edentulous regions, pathology, supernumerary teeth, artifacts, trauma, or surgical history in anterior maxilla.

Measurements: Gingival thickness measured at CEJ, bone crest, 3 mm and 5 mm apical to CEJ. Alveolar bone thickness measured at 3 mm and 5 mm apical to CEJ. ANB angle used to classify skeletal patterns (Class I, II, III).

Statistical Analysis: Descriptive statistics, Shapiro-Wilk test, Pearson/Spearman correlation, and Chi-square test using SPSS version 21.

Fig 1: Gingival Thickness at: 1. At cementoenamel junction
2. Coronal to bone crest
3. 3mm apical to CEJ
4. 5mm apical to CEJ

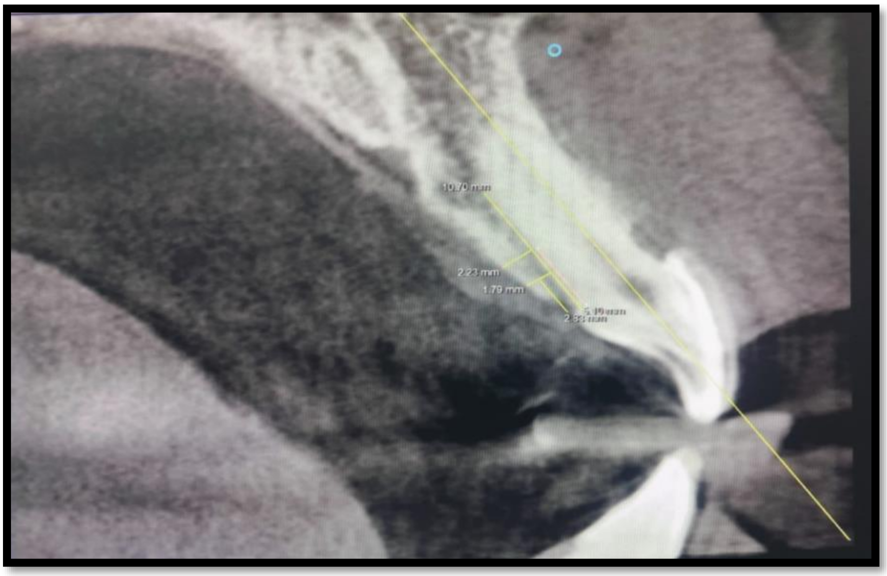

Fig 2: Alveolar bone thickness at :1. 3 mm apical to CEJ
2. 5 mm apical to CEJ

Results:

Table 1: Comparison of gingival thickness between males and females respectively

(in mm)	Males Mean (SD)	Females Mean (SD)	Unpaired t test	P value, Significance
At CEJ	**3.66 (0.64)**	**4.04 (1.08)**	**t = -4.150**	**p=0.037***
Coronal of bone crest	**3.66 (0.62)**	**3.85 (1.02)**	**t = -8.03**	**p=0.045***
3 mm apical of CEJ	**3.61 (0.54)**	**3.62 (0.97)**	**t = -0.081**	**p=0.872 (NS)**
5 mm apical of CEJ	**3.47 (0.44)**	**3.55 (0.84)**	**t = -0.237**	**p=0.351 (NS)**

p>0.05 – no significant difference ***p<0.05 – significant difference**

- Gingival Thickness (Table 1)
- At CEJ: Females (4.04 ± 1.08 mm) had significantly greater gingival thickness than males (3.66 ± 0.64 mm), *p = 0.037*.
- Coronal to bone crest: Females (3.85 ± 1.02 mm) also showed significantly greater thickness than males (3.66 ± 0.62 mm), *p = 0.045*.
- 3 mm and 5 mm apical to CEJ: No significant differences between sexes (*p = 0.872* and *p = 0.351* respectively).

Interpretation: Sex-related differences in gingival thickness are localized to the CEJ and coronal regions, but not evident apically.

Table 2: Comparison of alveolar bone thickness between males and females respectively

(in mm)	Males Mean (SD)	Females Mean (SD)	Unpaired t test	P value, Significance
3 mm apical to CEJ	**5.101 (0.547)**	**5.184 (0.717)**	**t = -0.358**	**p=0.723 (NS)**
5 mm apical to CEJ	**5.496 (0.781)**	**5.667 (0.709)**	**t = -0.627**	**p=0.536 (NS)**

p>0.05 – no significant difference

- Alveolar Bone Thickness (Table 2)

- 3 mm apical to CEJ: No significant difference (Males: 5.10 ± 0.55 mm; Females: 5.18 ± 0.72 mm; *p = 0.723*).
- 5 mm apical to CEJ: No significant difference (Males: 5.50 ± 0.78 mm; Females: 5.67 ± 0.71 mm; *p = 0.536*).
- Interpretation: Alveolar bone thickness is comparable between males and females at both measured levels.

Table 3: Comparison of facial type in males and females respectively

Facial type	Males N (%)	Females N (%)	Chi square test	P value, Significance
I	**9 (60%)**	**10 (66.7%)**	**Chi =0.386**	**P=0.824 (NS)**
II	**4 (26.7%)**	**4 (26.7%)**		
III	**2 (13.3%)**	**1 (6.7%)**		

p>0.05 – no significant difference

Facial Type Distribution (Table 3)

- Type I: Most common in both sexes (Males: 60%; Females: 66.7%).
- Type II: Equal distribution (26.7% each).
- Type III: Slightly more frequent in males (13.3%) than females (6.7%).
- Chi-square test: No significant difference (*p = 0.824*).

Interpretation: Facial type distribution does not differ significantly between sexes.
Comparison of gingival thickness revealed that females exhibited significantly greater values than males at the CEJ and coronal to the bone crest ($p < 0.05$). However, no significant differences were observed at 3 mm and 5 mm apical to the CEJ. Alveolar bone thickness did not differ significantly between sexes at either 3 mm or 5 mm apical to the CEJ ($p > 0.05$). Analysis of facial type distribution showed Type I as the most prevalent in both sexes, followed by Type II and Type III, with no statistically significant sex-related differences ($p = 0.824$).

Discussion:

The present study aimed to investigate the correlation between gingival phenotype in the maxillary anterior region and vertical facial skeletal patterns along with gender differences using CBCT imaging. Understanding this relationship is clinically significant because periodontal phenotype has emerged as a decisive factor in determining tissue response during orthodontic movement, implant placement, and restorative procedures.

Gingival phenotype has traditionally been assessed clinically through transgingival probing or visual inspection. However, these methods are subject to operator variability and limited precision. CBCT imaging offers a non-invasive, reproducible, and three-dimensional method for evaluating both soft tissue thickness and alveolar bone morphology. Previous investigations have demonstrated strong correlation between CBCT measurements and direct clinical measurements, supporting its reliability for morphometric analysis.

The biological rationale behind a potential association between craniofacial morphology and gingival phenotype lies in coordinated growth patterns of soft and hard tissues. Skeletal vertical growth patterns influence alveolar bone height, cortical plate thickness, and incisor inclination. In hyperdivergent individuals, thinner cortical plates and increased incisor proclination are frequently observed, which may predispose to reduced gingival thickness and higher susceptibility to recession. Conversely, hypodivergent patterns are often associated with thicker cortical plates and denser supporting structures.

If the findings of the present study demonstrate a statistically significant correlation between vertical skeletal type and gingival thickness, this would reinforce the hypothesis that craniofacial morphology plays a role in periodontal phenotype determination. Such findings would align with previous studies that reported moderate associations between periodontal tissue dimensions and skeletal characteristics.

Gender differences in gingival phenotype have also been reported in literature. Males are often described as having thicker gingival and alveolar bone dimensions compared to females, possibly due to hormonal influences, genetic determinants, and overall craniofacial size differences. Evaluating gender as a secondary variable in this study enhances its clinical applicability.

From an orthodontic perspective, gingival phenotype influences treatment risk assessment. Patients with thin gingival phenotype undergoing significant incisor proclination are at increased risk for gingival recession. Knowledge of underlying phenotype prior to treatment planning allows clinicians to consider preventive periodontal interventions, such as soft tissue grafting or controlled biomechanics.

In implant dentistry, tissue thickness plays a decisive role in esthetic outcomes. Thicker peri-implant mucosa is associated with improved papilla fill, reduced marginal bone loss, and enhanced long-term stability. Thus, understanding phenotype variations across different skeletal patterns may guide implant site preparation and augmentation strategies.

The present study uses standardized measurement levels (CEJ, bone crest, 3 mm and 5 mm apical to CEJ) ensures reproducibility and comparability with previous morphometric investigations. Furthermore, inclusion of inter-observer evaluation enhances reliability.

Despite its strengths, the study has limitations. The relatively small sample size may limit generalizability. The cross-sectional design prevents assessment of longitudinal changes. Additionally, CBCT imaging, while precise, involves radiation exposure and is not routinely indicated solely for soft tissue assessment.

Future research should incorporate larger, multicentric samples and possibly longitudinal evaluation to observe periodontal changes during orthodontic treatment across different skeletal patterns. Integration of digital intraoral scanning with CBCT may further enhance soft tissue visualization.

In conclusion, the interplay between gingival phenotype and craniofacial morphology represents an evolving area of interdisciplinary importance. The findings of this study may contribute to improved risk assessment models and personalized treatment planning in contemporary dental practice.

Conclusion:

Within the limitations of this CBCT-based pilot study, gingival phenotype in the maxillary anterior region may demonstrate correlation with vertical skeletal pattern and gender. Recognition of these relationships may enhance interdisciplinary treatment planning and periodontal risk assessment.

Conflict of interest: The authors declare no conflicts of interest

Referances:

1. Seibert JL, Lindhe J (1989) Textbook of clinical periodontology, 2nd edn. Black-well Munksgaard, Copenhangen

2. Cortellini P, Bissada NF (2018) Mucogingival conditions in the natural dentition: narrative review, case definitions, and diagnostic considerations. J Periodontol 89(Suppl 1): S204–S213. https://doi.org/10.1002/JPER.16-0671

3. KaoRT, Pasquinelli K (2002) Thick vs. thin gingival tissue: a key determinant in tissue response to disease and restorative treatment. J Calif Dent Assoc 30:521–526

4. Wiesner G, Esposito M, Worthington H, Schlee M (2010) Connective tissue grafts for thickening peri-implant tissues at implant placement. One-year results from an explanatory split-mouth randomized controlled clinical trial. Euri J Oral Implantol 3:27–35

5. Claffey N, Shanley D (1986) Relationship of gingival thickness and bleeding to loss of probing attachment in shallow sites following Clin Oral Invest nonsurgical periodontal therapy. J Clin Periodontol 13:654–657.

6. Pontoriero R, Carnevale G (2001) Surgical crown lengthening: a 12-month clinical wound healing study. J Periodontol 72:841–848.

7. Kois JC (2004) Predictable single-tooth peri-implant esthetics: five diagnostic keys. Compend Contin Educ Dent 25:895–896 898, 900 passim; quiz 906-897

8. Evans CD, Chen ST (2008) Esthetic outcomes of immediate implant placements. Clin Oral Implants Res 19:73–80. https://doi.org/ 10.1111/j.1600-0501.2007. 01413.x

9. Hwang D, Wang HL (2006) Flap thickness as a predictor of root coverage: a systematic review. J Periodontol 77:1625–1634. https:// doi.org/10.1902/jop.2006.060107

10. Baldi C, Pini-Prato G, Pagliaro U, Nieri M, Saletta D, Muzzi L, Cortellini P (1999) Coronally advanced flap procedure for root coverage. Is flap thickness a relevant predictor to achieve root coverage? A 19-case series. J Periodontol 70:1077–1084. https://doi. org/10.1902/jop.1999.70.9.1077

11. Berlucchi I, Franchetti L, Del Fabbro M, Basso M, Weinstein RL (2005) The influence of anatomical features on the outcome of gingival recessions treated with coronally advanced flap and enamel matrix derivative: a 1-year prospective study. J Periodontol 76: 899–907

12. ZweersJ, Thomas, SlotDE, WeisgoldAS, VanderWeijdenFG (2014) Characteristics of periodontal biotype, its dimensions, associations and prevalence: a systematic review. J Clin Periodontol 41: 958–971. https://doi.org/10.1111/jcpe.12275

13. Stein JM, Lintel-Hoping N, Hammacher C, Kasaj A, Tamm M, Hanisch O (2013) The gingival biotype: measurement of soft and hard tissue dimensions- a radiographic morphometric study. J Clin Periodontol 40:1132–1139.

14. Olsson M, Lindhe J, Marinello CP (1993) On the relationship between crown form and clinical features of the gingiva in adolescents. J Clin Periodontol 20:570–577

15. Park JH, Hong JY, Ahn HW, Kim SJ (2018) Correlation between periodontal soft tissue and hard tissue surrounding incisors in skeletal class III patients. Angle Ortho 88:91–99. https://doi.org/10. 2319/060117-367.1

16. Cuny-Houchmand M, Renaudin S, Leroux M, Planche L, Gehenna LL, Soueidan A (2013) Gingival biotype assessment: visual inspection relevance and maxillary versus mandibular comparison. Open Dent J 7:1–6. https://doi.org/10.2174/ 1874210601307010001

17. Kaya, Akano, Alkane A, Keskin's (2018) Gingival thicknesses of maxillary and mandibular anterior regions in subjects with different craniofacial morphologies. Am J Ortho Dentofac Ortho 154:356–364.

18. CookDR, Mealey, Verrett RG, Mills MP, Noujaim ME, Lasho DJ, Cronin RJ Jr (2011) Relationship between clinical periodontal biotype and labial plate thickness: an in vivo study. Int J Periodontics Restorative Dent 31:345–354

19. Kan JY, Morimoto T, Rungcharassaeng K, Roe P, Smith DH (2010) Gingival biotype assessment in the esthetic zone: visual versus direct measurement. Int J Periodontics Restorative Dent 30:237–243

20. La Rocca AP, Alemany AS, Levi P Jr, Juan MV, Molina JN, Weigold AS (2012) Anterior maxillary and mandibular biotype: relationship between gingival thickness and width with respect to underlying bone thickness. Implant Dent 21:507–515. https://doi. org/10.1097/ID.0b013e318271d487

21. Ronay V, Sharman P, Bindl A, Attin T, Schmidlin PR (2011) Current status and perspectives of mucogingival soft tissue measurement methods. J Esthetic Restore Dent 23:146–156. https://doi. org/10.1111/j.1708-8240.2011. 00424.x

22. Muller HP, Bareish-Nusair KM, Kononov E (2007) Repeatability of ultrasonic determination of gingival thickness. Clin Oral Investing 11:439–442.

23. Fu JH, Yeh CY, Chan HL, Tatarakis N, Leong DJ, Wang HL (2010) Tissue biotype and its relation to the underlying bone morphology. J Periodontol 81:569–574.

24. Cortellini P, Bissada NF (2018) Mucogingival conditions in the natural dentition: narrative review, case definitions, and diagnostic considerations. J Clin Periodontol 45(Suppl 20): S190–S198. https://doi.org/10.1111/jcpe.12948

25. ProffitW, FieldsHJr, SarverD (2007) Contemporary orthodontics, 4th edn. C.V. Mosby, St Louis.

26. Chaturvedi S, Haralur SB, Addas MK, Alfarsi MA. CBCT analysis of schneiderian membrane thickness and its relationship with gingival biotype and arch form. Nigerian journal of clinical practice. 2019 Oct 1;22(10):1448-56.

27.Das G, Ahmed AR, Suleman G, Lal A, Rana MH, Ahmed N, Arora S. A comparative evaluation of dentogingival tissue using transgingival probing and cone-beam computed tomography. Medicina. 2022 Sep 19;58(9):1312.

28. Lu JW, Shi X, Huang SH, Yan XZ, Hu CJ, Shi MY, Luo LJ. A novel cone-beam CT scanning technique for measuring periodontal soft tissues in the esthetic area. Journal of Oral Science. 2022;64(3):212-7.

29. Kong J, Hartsfield Jr JK, Aps J, Naoum S, Lee R, Miranda LA, Goonewardene MS. Effect of craniofacial morphology on gingival parameters of mandibular incisors. The Angle Orthodontist. 2023 Sep 1;93(5):545-51.