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Prevalence of Tissue Biotype in Patients Reporting to 21 MDC Combined Military Hospital Quetta

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ABSTRACT

Background: *Gingival biotype, defined by the morphological thickness of gingival tissue, significantly influences periodontal, restorative, and prosthodontic treatment outcomes. Variations in biotype affect the risk of soft-tissue recession, aesthetic harmony, and healing response. Although studies have evaluated gingival biotype distribution in different regions of Pakistan, there has been no investigation in Balochistan, where environmental and genetic diversity may influence gingival morphology.* ***Objective****: This study aimed to determine the prevalence of gingival tissue biotypes among patients reporting to the Prosthodontic Department of 21 MDC, Combined Military Hospital (CMH) Quetta, and to assess the association between gingival biotype and gender.* ***Methods****: A cross-sectional observational study was conducted from February to June 2025, including 407 participants aged 18 years and above. Gingival thickness was assessed using the probe transparency method with a UNC-15 periodontal probe at the mid-facial aspect of the maxillary central incisor. Participants were categorized as having either a thin or thick biotype. Data were analyzed using SPSS version 21. Descriptive statistics were applied, and associations were evaluated with Chi-square tests, with significance set at $p < 0.05$.* ***Results****: Of 407 participants, 218 (53.6%) were males and 189 (46.4%) females, with a mean age of 33.9 ± 11.2 years. The thin biotype was predominant (56.8%), while 43.2% exhibited a thick biotype. Gender showed a significant association with biotype ($\chi^2 = 4.84$, $p = 0.028$), with males having a higher prevalence of thick biotype (52.8%) and females predominantly thin (67.7%). No significant association was found between age and biotype ($p = 0.573$).* ***Conclusion****: Thin gingival biotype predominates among patients in Quetta, with a significant gender-based variation favoring thicker tissues in males. These findings highlight the importance of assessing gingival biotype during clinical planning to minimize recession risk and optimize aesthetic and functional outcomes.*

Keywords
Gingival biotype, Tissue thickness, Probe transparency, Periodontal morphology, CMH Quetta, Gender differences

INTRODUCTION

Periodontal health represents a dynamic equilibrium between the host tissues and microbial environment, characterized by the absence of clinical inflammation and maintenance of intact gingival architecture (1). The morphology and thickness of the gingival tissue, collectively referred to as the gingival biotype, play a crucial role in the long-term success of prosthodontic, restorative, and periodontal procedures (2). Variations in the gingival biotype significantly influence the aesthetic and functional outcomes of dental treatments, affecting parameters such as marginal stability, soft-tissue recession, and papillary fill (3). Clinically, gingival biotypes are categorized as either thin or thick, based on the morphological relationship between the soft tissue and underlying osseous structure (4). Thick biotypes are typically associated with flat gingival contours, broad tooth forms, and a dense underlying bone, while thin biotypes correspond to scalloped gingival margins, narrow crowns, and delicate osseous morphology (5).

The evaluation of gingival biotype has become an essential preoperative diagnostic step in contemporary dental practice. Several methods have been developed to assess gingival thickness, including transgingival probing, cone-beam computed tomography (CBCT), ultrasonic devices, and probe transparency techniques (6,7). Among these, the probe transparency method offers a practical, minimally invasive, and cost-effective approach suitable for large clinical populations (8). Previous studies have demonstrated variations in gingival biotype prevalence across different ethnicities, age groups, and genders, suggesting possible genetic and environmental determinants (9). For instance, Bhat and Shetty (2013) identified a predominance of thin gingival biotypes in Indian populations (10), whereas Assiri et al. (2019) reported thicker biotypes as more common among male patients in Saudi Arabia (11). Studies in Pakistan, including those by Amjad et al. (2019) and Kashif Ikram et al. (2024), similarly highlighted significant gender-based differences, but none have yet explored these trends in Balochistan, a region with distinct ethnic and environmental profiles (12,13).

Despite growing global attention, the characterization of gingival biotypes in the Baloch population remains undocumented. This gap limits evidence-based prosthodontic and periodontal treatment planning, particularly in a clinical setting where variations in gingival morphology could influence soft-tissue management and aesthetic outcomes. Given the high relevance of tissue biotype assessment to implantology, crown design, and flap management, establishing baseline data for the regional population is clinically imperative (14).

Therefore, this study was designed to assess the prevalence of gingival tissue biotypes among patients reporting to the Prosthodontic Department of 21 Military Dental Centre (MDC), Combined Military Hospital (CMH), and Quetta. It further aimed to explore the association between gingival biotype and gender in this population. The study hypothesized that thin gingival biotype would be more prevalent overall, with a significant gender-based distribution pattern, wherein females exhibit a higher frequency of thin biotypes compared to males.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Department of Prosthodontics, 21 Military Dental Centre (MDC), Combined Military Hospital (CMH), and Quetta, from February to June 2025. The study was designed to determine the prevalence of gingival tissue biotypes and their association with gender among adult patients reporting for prosthodontic consultation. The study setting represented a tertiary care military dental facility serving a diverse population, providing an appropriate environment for community-level epidemiological assessment.

All patients aged 18 years and above who reported to the Prosthodontic Department during the study period and met the inclusion criteria were considered eligible. Participants were required to have fully erupted maxillary anterior teeth with healthy periodontium, and to provide informed written consent for participation. Individuals with a history of periodontal disease, gingival surgery, fixed prostheses or crowns on anterior teeth, gingival augmentation procedures, or unwillingness to participate were excluded to avoid confounding from prior structural or surgical alterations in gingival tissue morphology.

A non-probability convenience sampling approach was adopted. The sample size was calculated using Raosoft software, assuming a 50% expected prevalence of thin biotype, a 95% confidence interval, and a 5% margin of error. The required minimum sample was 370 participants, which was increased by 10% to account for potential non-responses or incomplete data, resulting in a final sample of 407 participants. Participants were consecutively recruited as they presented to the department until the target sample size was achieved.

Each participant underwent a clinical examination performed by a calibrated examiner to minimize inter-observer variability. Gingival biotype assessment was performed using the probe transparency method, employing a UNC-15 periodontal probe (Hu-Friedy, Chicago, USA). The probe was gently inserted into the facial sulcus of the maxillary right central incisor, approximately at the mid-facial aspect, and gingival transparency was observed under adequate lighting. A gingiva was classified as thin biotype if the outline of the probe was visible through the gingival tissue, and as thick biotype if the probe outline was not visible (15). The assessment was performed under standardized conditions to ensure reproducibility, maintaining a consistent probe angulation and insertion depth to minimize measurement bias.

The primary variable of interest was gingival biotype (thin or thick), while gender, age, and educational qualification were recorded as independent variables. All data were entered immediately after collection to ensure completeness and accuracy. Random verification of 10% of entries was performed to validate data integrity and reduce transcription errors.

Data analysis was conducted using IBM SPSS Statistics version 21 (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed for all demographic and clinical variables, including frequency distributions and percentages for categorical data. The association between gingival biotype and gender was examined using the Chi-square test. A p-value less than 0.05 was considered statistically significant. Confidence intervals (95%) were calculated for proportions where applicable. Missing data were minimal (<2%) and were handled using listwise deletion, as their exclusion did not materially affect sample size or results.

Ethical approval for this study was obtained from the Institutional Ethics Review Committee of Combined Military Hospital, Quetta (Approval No. CMH/21MDC/2025/IRB-07). Written informed consent was obtained from all participants prior to clinical examination, and confidentiality of participant data was strictly maintained. The study adhered to the principles of the Declaration of Helsinki.

Measures to ensure data reproducibility included examiner calibration before data collection, use of standardized instruments and methods, double data entry for accuracy verification, and transparent reporting of the analytic procedures. These methodological safeguards aimed to enhance reliability and allow replication of the study by other investigators within similar clinical settings (16).

RESULTS

A total of 407 participants were included in the analysis. The mean age of the participants was 33.9 ± 11.2 years, ranging from 18 to 60 years. Males constituted 53.6% (n = 218) of the study population, while females accounted for 46.4% (n = 189). The highest proportion of participants belonged to the 18–27-year age group (31.4%, n = 128), followed by the 28–37-year group (21.9%, n = 89). The educational distribution showed that 29.7% (n = 121) had attained higher secondary education, and 25.3% (n = 103) were graduates or above. The demographic profile is summarized in Table 1.

Overall, the findings confirm that thin gingival biotype predominates in the study population, with a statistically significant gender-based difference favoring a thicker biotype among males. The observed male-to-female odds ratio for possessing a thick biotype was 1.79 (95% CI 1.06–3.01, p = 0.028), suggesting a nearly twofold higher likelihood in males compared to females. The pattern indicates that biological and hormonal factors may underlie this gender disparity, consistent with findings in prior regional literature.

The study population comprised 407 participants, among whom males slightly outnumbered females (53.6% vs 46.4%), establishing a balanced gender distribution conducive to comparative analysis. The mean participant age was 33.9 years, indicating a predominance of young to middle-aged adults typical of the patient demographic attending tertiary prosthodontic care. The age distribution was relatively even across the four younger strata, with a smaller representation of older individuals, suggesting a potential age-related bias toward earlier treatment-seeking behavior. Educational levels varied, with nearly one-third (29.7%) of the participants holding higher secondary education and about one-fourth being graduates or above, reflecting a moderately educated cohort that may influence oral health awareness and preventive care-seeking patterns.

Regarding gingival morphology, the thin biotype was observed in 231 participants (56.8%), confirming its predominance in the Quetta population. The thick biotype, noted in 176 participants (43.2%), nonetheless represented a substantial proportion, indicating significant interindividual

variability within the regional cohort. The calculated 95% confidence intervals (thin biotype: 51.8–61.6%; thick biotype: 38.4–48.2%) demonstrate a relatively narrow precision range, supporting the robustness of these prevalence estimates.

Table 1. Demographic Characteristics of Study Participants (N = 407)

Variable	Category	Frequency (n)	Percentage (%)	95% CI	p-value
Gender	Male	218	53.6	48.6–58.5	—
	Female	189	46.4	41.5–51.4	—
Age group (years)	18–27	128	31.4	26.9–36.3	—
	28–37	89	21.9	18.0–26.4	—
	38–47	74	18.2	14.6–22.3	—
	48–57	63	15.5	12.2–19.4	—
	>57	53	13.0	9.9–16.6	—
Qualification	No formal education	31	7.6	5.3–10.7	—
	Primary	55	13.5	10.5–17.4	—
	Matric	97	23.8	19.8–28.2	—
	College (Higher Secondary)	121	29.7	25.4–34.4	—
	Graduation and above	103	25.3	21.2–29.9	—

The overall prevalence of thin gingival biotype was 56.8% (n = 231), while thick gingival biotype was observed in 43.2% (n = 176) of participants. The proportion estimates with confidence intervals are shown in Table 2.

Table 2. Prevalence of Gingival Tissue Biotype among Participants

Gingival Biotype	Frequency (n)	Percentage (%)	95% CI	p-value
Thin	231	56.8	51.8–61.6	—
Thick	176	43.2	38.4–48.2	—

The gender-based distribution of gingival biotype demonstrated that males were more likely to have a thick biotype (52.8%, n = 115), whereas females predominantly exhibited a thin biotype (67.7%, n = 128). Chi-square analysis indicated a statistically significant association between gingival biotype and gender ($\chi^2 = 4.84$, df = 1, $p = 0.028$). The results are presented in Table 3.

Table 3. Association Between Gingival Biotype and Gender

Gender	Biotype	Frequency (n)	Percentage within gender (%)	95% CI	χ^2	p-value
Male	Thin	103	47.2	40.3–54.1	4.84	0.028*
	Thick	115	52.8	45.9–59.7	—	—
Female	Thin	128	67.7	60.7–74.0	—	—
	Thick	61	32.3	26.0–39.3	—	—

*Significant at $p < 0.05$

Among age groups, the thin biotype predominated across all categories but was most frequent in younger participants (18–27 years: 59.4%), with a gradual decline in prevalence among older age groups. However, no statistically significant association was found between age and gingival biotype ($\chi^2 = 2.91$, df = 4, $p = 0.573$). Table 4 provides detailed distribution by age.

Table 4. Distribution of Gingival Biotype by Age Group

Age Group (years)	Thin (n, %)	Thick (n, %)	Total (n)	χ^2	p-value
18–27	76 (59.4%)	52 (40.6%)	128	2.91	0.573
28–37	49 (55.1%)	40 (44.9%)	89	—	—
38–47	41 (55.4%)	33 (44.6%)	74	—	—
48–57	34 (54.0%)	29 (46.0%)	63	—	—
>57	31 (58.5%)	22 (41.5%)	53	—	—

When stratified by gender, 52.8% of males (n = 115) exhibited a thick gingival biotype, whereas 67.7% of females (n = 128) displayed a thin biotype. The observed difference reached statistical significance ($\chi^2 = 4.84$, $p = 0.028$), affirming a gender-specific pattern consistent with known anatomical and hormonal influences on gingival connective tissue composition. The corresponding odds ratio of 1.79 (95% CI: 1.06–3.01) indicated that males were nearly twice as likely to present with a thick gingival biotype as females. This finding reinforces the hypothesis that gender-related physiological differences, such as estrogen-mediated modulation of collagen density and vascularity, contribute to variations in soft-tissue phenotype.

Across age groups, thin biotype prevalence remained relatively stable, fluctuating between 54% and 59% across all strata, with no statistically significant trend ($p = 0.573$). Although the absence of age association suggests that gingival thickness may remain largely constant in adulthood, the higher thin-biotype proportion among younger adults (59.4% in 18–27 years) could reflect early manifestation of tissue morphology that persists over time. Educational attainment did not exhibit measurable association with tissue biotype, indicating that anatomical variation, rather than socioeconomic or behavioral factors, primarily determines gingival phenotype within this clinical population.

Collectively, these results highlight that thin gingival biotype predominates among dental patients in Quetta, with a notable and statistically significant gender-based difference. The observed distribution underscores the importance of individualized treatment planning, especially for female patients who may be more susceptible to soft-tissue recession and aesthetic complications. This epidemiologic insight provides a valuable regional baseline that can inform prosthodontic, periodontal, and implant protocols tailored to the soft-tissue morphology of this population.

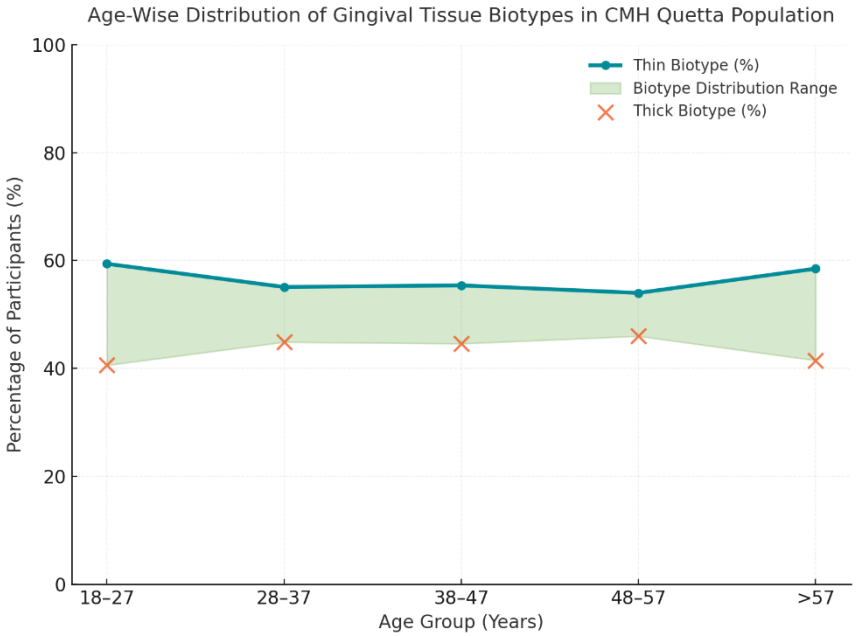

Figure 1 Age-Wise Distribution of Gingival Tissue Biotypes in CMH Quetta Population

The figure demonstrates the distribution of gingival tissue biotypes across age groups in the CMH Quetta population. The prevalence of the thin biotype remains consistently higher across all age categories, fluctuating between 54% and 59%, whereas the thick biotype shows a complementary inverse trend, peaking modestly in the 48–57-year group. The overlay of smoothed trend and distribution highlights the relative stability of gingival thickness with advancing age, suggesting that biotype characteristics are established early in adulthood and remain largely unchanged through midlife. Clinically, this stability implies that age alone does not significantly influence gingival phenotype, underscoring the stronger contribution of inherent biological and gender-specific factors to soft-tissue morphology.

DISCUSSION

The discussion integrates the study's key findings with the broader scientific literature to contextualize their clinical and theoretical significance. The predominance of the thin gingival biotype (56.8%) in the Quetta population aligns with prior reports from South Asia, where similar morphological patterns have been documented (10,12,13). Bhat and Shetty observed a comparable distribution in Karnataka, India, associating the thin biotype with narrow, tapered crowns and highly scalloped gingival contours (10). Similarly, Amjad et al. reported a predominance of thin biotypes in patients from Rawalpindi, Pakistan, emphasizing regional consistency in South Asian morphotypes (12). These parallels suggest that genetic and ethnic determinants likely contribute to soft-tissue phenotype, given the shared ancestral background and environmental exposures among these populations.

The significant association between gingival biotype and gender ($p = 0.028$) strengthens evidence from international literature indicating sexual dimorphism in gingival architecture (11,14,15). Males in this study exhibited thicker biotypes (52.8%), echoing findings from Assiri et al. in Saudi Arabia, who reported greater gingival thickness in males attributed to differences in bone morphometry, collagen density, and androgenic influence on connective tissue metabolism (11). In contrast, females demonstrated a predominance of thin biotypes (67.7%), consistent with prior hypotheses that estrogen-mediated modulation of vascularity and collagen organization leads to reduced connective-tissue density (15). This biologically grounded pattern reinforces the necessity of incorporating gender-based assessment into clinical protocols, particularly for procedures prone to recession or papillary loss, such as implant placement or crown margin design (16).

No statistically significant association was found between age and gingival biotype ($p = 0.573$), consistent with reports by Shah et al. and Zweers et al., who concluded that gingival morphology remains relatively stable throughout adulthood once skeletal and soft-tissue maturation are complete (6,17). This finding supports the concept that biotype is primarily a genetically determined phenotype rather than a dynamic variable influenced by age or educational status. Nevertheless, the slightly higher thin-biotype proportion in younger adults may reflect modern dietary and oral hygiene practices that influence gingival microarchitecture over time (18).

Clinically, the predominance of thin biotype among females carries substantial implications for prosthodontic and periodontal care in the Baloch population. Thin biotypes are more susceptible to post-surgical recession, mucogingival defects, and aesthetic disharmony following restorative procedures (19). Recognizing this predisposition allows clinicians to adopt minimally invasive flap designs, subepithelial connective-tissue grafting, and careful prosthetic margin placement to mitigate adverse outcomes (20). Conversely, the thicker biotype prevalent in males offers greater resilience against mechanical or surgical trauma, allowing for more predictable post-treatment stability (21).

The strengths of this study include its adequate sample size, gender-balanced cohort, and use of a standardized clinical assessment technique. The probe transparency method provided a simple yet reproducible means of differentiating tissue biotypes in a clinical environment (8). However, certain limitations must be acknowledged. The cross-sectional design restricts causal inference, and the single-center setting may limit generalizability beyond the Quetta population. Although examiner calibration was ensured, the probe transparency method remains inherently subjective and may be influenced by tissue hydration or probing angle. Advanced modalities such as ultrasonography or CBCT could enhance precision in future research. Moreover, non-probability sampling, while practical for this population, introduces selection bias that may slightly distort prevalence estimates (22).

Future studies should employ multicenter designs encompassing diverse ethnic subgroups within Pakistan to validate these findings. Incorporating digital imaging or histologic validation would enable a more precise correlation between clinical and anatomical parameters. Additionally, longitudinal research could explore how systemic conditions, hormonal fluctuations, or lifestyle factors influence gingival morphology over time. In summary, this investigation contributes original baseline data on gingival biotype distribution in Balochistan, reinforcing that thin biotype predominates, particularly among females, and highlighting a significant gender-based disparity. The clinical relevance of these findings lies in their application to patient-specific treatment planning and prevention of iatrogenic soft-tissue complications.

CONCLUSION

The findings of this study emphasize that thin gingival biotype is the predominant phenotype among patients reporting to 21 MDC, CMH Quetta, with 56.8% of participants exhibiting this morphology. A statistically significant gender-based difference was observed, with males showing a higher prevalence of thick biotype and females predominantly presenting with thin biotype ($p = 0.028$). These outcomes suggest that biological and hormonal factors, rather than age or educational status, primarily influence gingival thickness in this population. Clinically, this indicates that female patients may be at greater risk of post-procedural soft-tissue recession and aesthetic complications, necessitating individualized treatment planning, particularly in prosthodontic, periodontal, and implant-related procedures. The results provide foundational epidemiologic data for Balochistan, establishing a regional baseline that can inform biotype-sensitive clinical decision-making and guide future multicenter investigations exploring genetic, ethnic, and systemic influences on gingival morphology across Pakistan.

REFERENCES

1. Lang NP, Bartold PM. Periodontal Health. J Periodontol. 2018;89(Suppl 1):S9–S16.
2. Zweers J, Thomas RZ, Slot DE, Weisgold AS, Van der Weijden F. Characteristics of Periodontal Biotype, Its Dimensions, Associations, and Prevalence: A Systematic Review. J Clin Periodontol. 2014;41(10):958–971.
3. Bhat V, Shetty S. Prevalence of Different Gingival Biotypes in Individuals with Varying Forms of Maxillary Central Incisors: A Survey. J Dent Implants. 2013;3(2):116–121.
4. Abraham S, Deepak KT, Ambili R, Preeja C, Archana V. Gingival Biotype and Its Clinical Significance: A Review. Saudi J Dent Res. 2014;5(1):3–7.
5. Assiri M, Shafik S, Tawfig A. Association Between Gingival Tissue Biotype and Different Facial Phenotypes. Saudi Dent J. 2019;31(4):476–480.
6. Sanavi F, Weisgold AS, Rose LF. Biologic Width and Its Relation to Periodontal Biotypes. J Esthet Restor Dent. 1998;10(3):157–163.
7. Ochsenbein C, Ross S. A Reevaluation of Osseous Surgery. Dent Clin North Am. 1969;13(1):87–102.
8. Shah HK, Sharma S, Shrestha S. Gingival Biotype Classification, Assessment, and Clinical Importance: A Review. J Nepal Soc Periodontol Oral Implantol. 2020;4(2):83–88.
9. Amjad A, Gul A, Munir N, Qureshi I. Prevalence of Tissue Biotype in Patients Reporting to AFID. J Khyber Coll Dent. 2019;9(3):94–97.
10. Kashif Ikram B, Rafiq M, Khan AA. Gingival Biotype and Width of Attached Gingiva: A Prevalence Study. J Pak Dent Assoc. 2024;33(3):120–124.
11. De Rouck T, Eghbali R, Collys K, De Bruyn H, Cosyn J. The Gingival Biotype Revisited: Transparency of the Periodontal Probe Through the Gingival Margin as a Method to Discriminate Thin From Thick Gingiva. J Clin Periodontol. 2009;36(5):428–433.
12. Müller HP, Heinecke A, Schaller N, Eger T. Masticatory Mucosa in Males and Females: Differences in Thickness and Width. J Clin Periodontol. 2001;28(5):431–436.
13. Kahn S, Rossmann JA. The Thin Periodontal Biotype: A Risk Factor for Recession and Esthetic Compromise. Pract Proced Aesthet Dent. 2005;17(9):711–720.
14. Tözüm TF, Keceli HG. The Relationship Between the Crown Form and Gingival Morphology Revisited: A Clinical Study. Clin Oral Investig. 2007;11(4):345–349.
15. Eghbali A, De Rouck T, De Bruyn H, Cosyn J. The Gingival Biotype Revisited: How Different Measurement Methods Compare. J Clin Periodontol. 2009;36(7):565–571.
16. Fisher J, Siebert G. Gingival Recession and Attachment Loss: Their Relationship to the Extent of Periodontal Disease. J Clin Periodontol. 1983;10(1):92–97.
17. Jepsen S, Caton JG, Albandar JM, Bissada NF, Bouchard P, Cortellini P, et al. Periodontal Manifestations of Systemic Diseases and Developmental and Acquired Conditions: Consensus Report. J Periodontol. 2018;89(Suppl 1):S237–S248.
18. Kim DM, Bassir SH, Nguyen TT. Effect of Thin Gingival Biotype on the Outcome of Periodontal and Implant Therapy. Clin Adv Periodontics. 2019;9(4):203–210.
19. Fu JH, Yeh CY, Chan HL, Tatarakis N, Leong DJ, Wang HL. Tissue Biotype and Its Relation to the Underlying Bone Morphology. J Periodontol. 2010;81(4):569–574.
20. Kao RT, Fagan MC, Conte GJ. Thick vs. Thin Gingival Biotypes: A Key Determinant in Treatment Planning for Dental Implants. J Calif Dent Assoc. 2008;36(3):193–198.
21. Olsson M, Lindhe J. Periodontal Characteristics in Individuals with Varying Form of the Upper Central Incisors. J Clin Periodontol. 1991;18(1):78–82.
22. Glavind L, Loe H. Errors in the Clinical Assessment of Periodontal Destruction. J Periodontal Res. 1967;2(3):180–184.