

# Assessment of gingival biotype and its relationship with age, gender and tooth shape in Congolese subjects: A cross-sectional study

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## ABSTRACT

### Introduction

Gingival thickness is an important parameter in predicting outcomes of dental treatment in general, and restorative procedures in particular.

### Purpose

This study aimed to evaluate gingival biotype in Congolese subjects and to determine its relationship with age, gender, and tooth shape.

### Methods

This cross-sectional study included 129 periodontally healthy subjects aged 18–50 years with bilateral maxillary central incisors in normocclusion. Gingival biotype was classified as thin or thick using the probe transparency method. Tooth (crown) shape was also recorded. Fisher's exact test and the chi-square test were used for statistical analysis.

### Results

Females predominated in the sample (58.9%), and the mean age was  $24.6 \pm 8.2$  years. Thick gingival biotype was the most prevalent (55%). The square/square-tapered tooth shape was the most common morphology (62.8%). Participants with square/square-tapered tooth shape were predominant in both males (54.7%) and females (68.4%) compared with those with triangular tooth form. No significant association was found between gingival biotype and age ( $\chi^2 = 0.089$ ,  $p = .765$ ) or gender ( $\chi^2 = 0.177$ ,  $p = .674$ ). In contrast, a significant association was found between tooth shape and gingival biotype ( $\chi^2 = 31.875$ ,  $p < .001$ ).

### Conclusions

Thick gingival biotype was predominant, and gingival phenotype appears closely linked to tooth morphology. These findings highlight the clinical importance of integrating tooth morphology into periodontal assessment and treatment planning, given its potential influence on tissue response and therapeutic outcomes.

## INTRODUCTION

Gingival biotype (also referred to as gingival phenotype) refers to the faciopalatal thickness of the gingiva, and its clinical characteristics vary among individuals (Sharma et al., 2023). It is associated with the response of periodontal tissues to physical, chemical, or bacterial insults, as well as outcomes of restorative and periodontal therapy, root coverage procedures, and overall dental esthetics (Shah et al., 2015).

Gingival biotype is generally classified into two main types: thin and thick. Thick biotypes are typically characterized by a flat gingival architecture, well-defined underlying bone morphology, dense and fibrotic soft tissues, and a wider band of keratinized tissue. In contrast, thin biotypes are more delicate, highly scalloped, and often translucent. In such cases, soft tissues appear fragile, with a reduced width of keratinized tissue and a thin buccal bone plate, frequently associated with dehiscences and fenestrations (Herrera-Serna et al., 2022; Olsson et al., 1991, 1993).

Several methods have been proposed to measure gingival thickness, including probe transparency, ultrasonic devices, endodontic spreaders, endodontic files, and calipers. More recently, cone beam computed tomography (CBCT) has been introduced as an alternative technique (Barriviera et al., 2009).

Periodontal phenotype has been increasingly studied due to its clinical relevance in periodontics, implant dentistry, orthodontics, and restorative dentistry. In clinical practice, accurate assessment of gingival biotype is essential for therapeutic decision-making (Al-Thomali et al., 2023). A thorough understanding of the patient's gingival biotype, including its prevalence and its relationship with other clinical parameters, is therefore important for achieving optimal treatment outcomes (Shao et al., 2018).

Most prevalence studies have been conducted in Caucasian, Asian, or Middle Eastern populations. These studies report that the prevalence of thick gingival biotype ranges from 50% to 83%, whereas thin gingival biotype ranges from 17% to 50% (Fischer et al., 2015; Frost et al., 2015; Nik-Aziz et al., 2023; Shah et al., 2015; Zawawi et al., 2012). Gingival biotype characteristics are influenced by

several factors, including ethnicity, genetic background, age, gender, and dental morphology.

However, data on African populations, particularly Congolese individuals, remain scarce. This gap is important because interethnic anatomical and genetic variations may influence both the distribution of periodontal phenotypes and tissue responses to treatment. Without population-specific evidence, clinicians may lack sufficient information to optimize periodontal treatment planning for local populations.

Therefore, this study sought to answer the following research question: *What is the prevalence of different gingival biotypes in Congolese subjects, and how are they associated with age, gender, and tooth morphology?* By addressing this question, the study aimed to provide local epidemiological data and support evidence-based clinical decision-making.

## METHODS

### *Study Design*

This cross-sectional study aimed to evaluate gingival biotype in Congolese subjects and its relationship with age, gender, and tooth shape.

### *Study Setting*

This study was conducted from March 15 to May 15, 2023, at the Periodontology Service of the University of Kinshasa Clinics (UKC), located in the commune of Lemba in Kinshasa Province, Democratic Republic of the Congo. The UKC is a major hospital complex with 12 specialized departments providing a wide range of medical and surgical services. The Department of Odonto-Stomatology includes six specialized services. The Periodontology Service focuses on the diagnosis and management of periodontal diseases affecting the gingiva and supporting tissues, as well as peri-implant diseases.

### *Study Population and Sampling*

The study population consisted of patients attending the Department of Odonto-Stomatology. Participants were selected using convenience sampling based on availability. A total of 129 participants aged 18–50 years were included. Written informed consent was obtained from all participants. Periodontally healthy subjects with bilateral maxillary central incisors present in normocclusion were

included. Subjects were excluded if they were missing maxillary central incisors; had restorations on maxillary central incisors; presented orthodontic problems or were undergoing orthodontic treatment; were pregnant or lactating; were taking medications; or had systemic diseases or conditions affecting periodontal supporting tissues.

The participant selection process is illustrated in **Figure 1**. Study variables included age, gender, oral hygiene, periodontal status, tooth type and shape, and gingival biotype.

#### Data Collection

All data were collected during clinical examination and recorded using a standardized data collection form designed for this study. Participants were seated in a dental chair under scalytic illumination.

A UNC-15 periodontal probe (Hu-Friedy, USA) was used to categorize gingival biotype. The probe was inserted into the gingival sulcus at the midfacial aspect of the maxillary central incisors. Gingival biotype was classified as thin or thick based on probe visibility through the gingival margin. If the outline of the periodontal probe was visible through the gingiva, the biotype was classified as thin. If the probe was not visible, the biotype was classified as thick.

Tooth (crown) shape was determined by visual inspection using a photograph of the maxillary central incisors. Tooth morphology was categorized as square/square-tapered or triangular based on criteria widely used in periodontal research (Olsson & Lindhe, 1991). For analytical purposes, square and square-tapered forms were grouped into a single category due to their similar morphological characteristics and clinical behavior.

#### Data Reliability and Validity

To minimize examiner bias, all measurements were performed by a single calibrated examiner. Intra-examiner reliability was assessed by repeating measurements in 13 participants after a 24-hour interval. Cohen's kappa coefficient was 0.92 (95% CI [0.85, 0.97]), indicating almost perfect agreement and confirming excellent examiner calibration.

#### Data Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 20.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were reported as mean  $\pm$  standard deviation (SD), while qualitative variables were reported as absolute and relative frequencies. The chi-square test and Fisher's exact test were used to assess associations between qualitative variables. Statistical significance was set at  $p < .05$ .

#### Ethical Considerations

This study was approved by the Institutional Ethics Committee of the Faculty of Dental Medicine, University of Kinshasa.

## RESULTS

**Table 1:**  
Sociodemographic Characteristics of Participants (N = 129)

Variable	Category	n	%
Age	< 25 years	76	58.9
	$\geq$ 25 years	53	41.1
Gender	Male	53	41.1
	Female	76	58.9

Note. Mean age = 24.6  $\pm$  8.2 years.

**Table 1** shows that females represented 58.9% of participants, whereas males accounted for 41.1%. The mean age was 24.6  $\pm$  8.2 years, and most participants (58.9%) were younger than 25 years.

**Table 2**  
Distribution of Clinical Variables (N = 129)

Variable	Category	n	%
Gingival biotype	Thin	58	45.0
	Thick	71	55.0
Tooth shape	Square/Square-tapered	81	62.8
	Triangular	48	37.2

**Table 2** indicates that thick gingival biotype was predominant (55%). The most prevalent tooth morphology was square/square-tapered (62.8%).

**Figure 2:**  
Prevalence of Tooth Shape by Gender

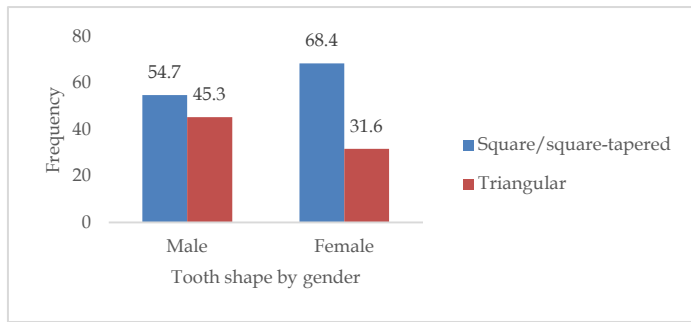


Figure 2 shows that square/square-tapered tooth shape predominated in both males (54.7%) and females (68.4%) compared with triangular tooth shape.

**Table 3:**  
Association Between Age, Gender, Tooth Shape, and Gingival Biotype (N = 129)

Variable	Category	Thin n (%)	Thick n (%)	$\chi^2$	<i>p</i>
Age	< 25 years	35 (46.1)	41 (53.9)	0.089	.765
	≥ 25 years	23 (43.4)	30 (56.6)		
Gender	Male	25 (47.2)	28 (52.8)	0.177	.674
	Female	33 (43.4)	43 (56.6)		
Tooth shape	Square/Square-tapered	21 (25.9)	60 (74.1)	31.875	< .001*
	Triangular	37 (77.1)	11 (22.9)		

Note. *p* values are based on chi-square test results. Significant at *p* < .05.

Table 3 shows that thick gingival biotype was more prevalent overall, particularly among participants with square/square-tapered tooth forms. In contrast, thin biotype was predominant among participants with triangular tooth shape. No significant associations were found between gingival biotype and age (*p* = .765) or gender (*p* = .674). However, a statistically significant association was observed between gingival biotype and tooth shape (*p* < .001).

## DISCUSSION

Gingival biotype plays a major role in maintaining periodontal health, as periodontal anatomy influences tissue behavior in response to physical, chemical, or bacterial insults. Therapeutic procedures such as periodontal surgery, implant surgery, and orthodontic treatment also require gingival biotype assessment prior to treatment (Singh et al., 2016).

To our knowledge, this is the first study to report the prevalence of gingival biotype and its relationship with clinical parameters in a Congolese population.

In the present study, thick gingival biotype was more prevalent than thin biotype. This finding is consistent with De Rouck et al. (2009), who reported a predominance of thick biotype (approximately two-thirds) compared with thin biotype (one-third). Similarly, Shao et al. (2018), in a study of a young Chinese population, reported that 40.3% had a thin phenotype, whereas 59.7% had a thick phenotype. Shah et al. (2015) also reported prevalences of 43.2% for thin and 56.7% for thick gingival phenotype. In contrast, Collins et al. (2021) reported no significant difference between thin and thick biotypes.

The existing literature suggests that gingival phenotype may vary across ethnic groups, with Asian populations often presenting thinner gingival tissues compared with Caucasian populations (De Rouck et al., 2009; Shao et al., 2018). However, few studies have been conducted exclusively in African populations. It should also be noted that methodology differs across studies, which may contribute to variation in reported prevalence. For example, Sharma et al. (2023) and Singh et al. (2016) evaluated multiple teeth in both the maxilla and mandible, whereas Collins et al. (2021) and the present study limited assessment to the maxillary central incisors. This methodological variation may influence the observed distribution of gingival phenotypes.

Patients with a thin gingival biotype exhibit increased susceptibility to connective tissue loss and epithelial damage, requiring atraumatic treatment approaches and meticulous oral hygiene. Due to reduced tissue stability, these patients are more prone to papillary and marginal gingival recession. Therefore, subgingival margin placement and crown lengthening procedures should be planned cautiously in individuals with a thin gingival biotype (Barriviera et al., 2009; Shah et al., 2015). In response to inflammation or other insults, thick biotypes tend to show fibrotic changes and pocket formation, whereas thin biotypes tend to exhibit inflammation and gingival recession. Thick gingiva, due to its dense and fibrotic nature and broader zone of attachment, is more resistant to recession. Conversely, thin gingiva is fragile and more susceptible to recession, bleeding, and inflammation (Nagaraj et al., 2010).

In the present study, no statistically significant association was found between gender and gingival biotype ( $p = .674$ ). Similar findings were reported by Collins et al. (2021) and Stellini et al. (2013). In contrast, De Rouck et al. (2009) reported that thin biotype was more common in women, whereas thick biotype predominated in men. Kolte et al. (2014) also reported a significant association. These inconsistencies may be explained by differences in sample size, demographic characteristics, and ethnic composition of study populations.

Regarding age, Collins et al. (2021) found no association between gingival phenotype and age in a Dominican adult population. Similarly, the present study found no significant relationship between age and gingival biotype. However, Kolte et al. (2014), in a study involving 120 subjects divided into three age groups, reported that younger individuals exhibited significantly thicker gingiva than older individuals. Other studies have supported these findings, concluding that thick gingiva is more common in younger than older individuals (Assiri et al., 2019; Vandana & Savitha, 2005). The relatively young age of participants in the present study may partly explain the predominance of thick gingival biotype.

A strong association was observed between tooth form and gingival biotype ( $p < .001$ ). Thin gingival phenotype was more common in participants with triangular tooth shape, whereas thick biotype was more prevalent in those with square/square-tapered tooth forms. These findings are consistent with Olsson et al. (1991, 1993), who reported a strong association between thick gingival biotype and square-shaped crowns. In contrast, Collins et al. (2021) reported different findings, noting that thin phenotype predominated in square and square-tapered morphologies, whereas thick phenotype was more frequent among triangular tooth forms.

Genetic and ethnic factors may influence gingival phenotype. Nevertheless, studies examining the relationship between crown morphology and periodontal biotype across ethnic groups remain limited. Tsukiyama et al. (2012) reported that Asian individuals tend to present more slender crown forms than Caucasian individuals. However, data regarding African populations remain insufficient.

Clinically, understanding the relationship between gingival biotype and tooth morphology is important for treatment planning. It may help predict esthetic outcomes and soft tissue stability in prosthodontics, evaluate recession risk during orthodontic treatment, and guide implant placement and soft tissue management in implant dentistry (Koukos et al., 2025).

This study has limitations. Because it was conducted among patients attending the periodontology department, it may be subject to selection bias. Future studies should involve larger, randomly selected population-based samples to improve generalizability.

### Recommendations

Based on the findings of this study, clinicians should systematically assess gingival phenotype during routine periodontal examinations. Particular attention should be given to patients with triangular tooth morphology, as this form appears more frequently associated with a thin gingival phenotype, which may increase susceptibility to gingival recession and reduced soft tissue stability.

### CONCLUSION

Within the limitations of this study, the observed association between tooth morphology and gingival biotype highlights the importance of considering crown shape in periodontal assessment and treatment planning. Clinically, recognizing that triangular teeth are more likely to present a thin biotype, whereas square or square-tapered teeth are more commonly associated with a thick biotype, may help guide surgical and restorative decisions and improve prediction of tissue response and esthetic outcomes. Further studies involving larger and more diverse populations are warranted to confirm these findings and to explore their implications for personalized periodontal therapy.

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**Ethical Approval:** This study was approved by the Institutional Ethics Committee of the Faculty of Dental Medicine, University of Kinshasa.

**Conflicts of Interest:** None declared.

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