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Original Research Article **Periodontology**

To Assess Gingival Biotype and Compare its Impact on Periodontal Parameters: Probing Depth and Gingival Recession – A Cross-Sectional Study

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Abstract

Background: Gingival biotype (now often termed periodontal phenotype) describes gingival thickness, keratinized tissue width, and underlying bone morphology. This phenotype has significant influence on periodontal disease progression, clinical outcomes, aesthetic stability, and response to therapy. ***Aim:*** To assess gingival biotype distribution in a defined population and evaluate its association with periodontal parameters, specifically probing depth and gingival recession. ***Materials and Methods:*** A cross-sectional analytical study involving 85 systemically healthy subjects aged 20–40 years was conducted. Gingival biotype was assessed by both probe transparency and transgingival probing methods. Probing depth and gingival recession were recorded for mandibular anterior teeth. SPSS software employed appropriate inferential statistics; $p<0.05$ was considered significant. ***Results:*** Thin gingival biotype was predominant, and there were statistically significant associations between biotype and both probing depth and gingival recession ($p<0.05$). ***Conclusion:*** Gingival biotype significantly influences periodontal parameters; therefore, routine assessment should be standard in periodontal diagnosis and treatment planning.

Keywords: Gingival biotype, periodontal phenotype, gingival thickness, probing depth, gingival recession.

INTRODUCTION

Gingival biotype refers to the thickness of the gingival tissue in the facio-palatal dimension and is considered a key determinant of periodontal health, tissue stability, and aesthetic outcomes. Variations in gingival morphology influence the tissue response to inflammation, trauma, and therapeutic interventions, thereby affecting both disease progression and treatment outcomes.[1] In recent literature, the term gingival phenotype has been introduced to provide a more comprehensive description of periodontal soft tissues, incorporating gingival thickness, width of keratinized tissue, and the morphology of the underlying alveolar bone, rather than relying on a simple binary classification.[2]

Traditionally, gingival morphology has been categorized into thin-scalloped and thick-flat biotypes.[3] Thin biotypes are characterized by delicate gingival tissues, a narrow zone of keratinized gingiva, pronounced scalloping of the gingival margin, and thin underlying alveolar bone. These characteristics make the tissues more susceptible to gingival recession, clinical attachment loss, and unfavourable responses to inflammatory or mechanical insults. [4,6] In contrast, thick biotypes exhibit dense, fibrotic gingiva, flatter gingival contours, a wider band of keratinized tissue, and thicker alveolar bone, which confer greater resistance to periodontal breakdown and enhanced stability following surgical and restorative procedures. [3,7]

The clinical significance of gingival biotype has been well documented in periodontal, restorative, and implant dentistry. Several studies have demonstrated that individuals with a thin gingival biotype are at a higher risk of gingival recession following non-surgical

periodontal therapy, periodontal flap surgery, orthodontic tooth movement, and implant placement. [2,8,9] Conversely, thick gingival biotypes are associated with improved wound healing, better soft tissue stability, and more predictable aesthetic outcomes. [10]

Probing depth and gingival recession are fundamental clinical parameters used to assess periodontal health and disease severity. Gingival thickness has been shown to influence probing depth measurements due to variations in tissue compressibility and inflammatory response[11] Gingival recession, in particular, is more frequently observed in thin gingival phenotypes and poses a significant challenge in periodontal practice due to its functional and aesthetic implications. [5,12]

Despite substantial evidence highlighting the importance of gingival biotype, limited population-based clinical studies have systematically evaluated its relationship with routine periodontal parameters such as probing depth and gingival recession. Therefore, the present study was undertaken to assess gingival biotype in a defined population and to evaluate its influence on probing depth and gingival recession, thereby contributing to improved periodontal risk assessment and individualized treatment planning.

MATERIALS AND METHODS

Study Design and Population

A total of 85 systemically healthy individuals, more than that of sample size were enrolled of different age groups ranging from 20 to 40 years of age who came to the out-patient Department of Periodontology and Implantology, Institute of Dental Sciences and Research, Nashik, Maharashtra, India, were randomly selected for the study. After obtaining the ethical board clearance, the subjects were provided with an informed consent for participating in the present study. All subjects were then provided with oral hygiene instructions preceded by oral prophylaxis, if necessary. A cross-sectional analytical design was used.

Inclusion Criteria:

- Subjects presenting all mandibular incisors
- All adjacent teeth to be intact
- Patients with in age group of 20-40 years
- No periodontal therapy in past 6 months

Exclusion Criteria:

- Systemic health compromise
- Pregnancy/lactation
- Mal-aligned anterior teeth
- Mucogingival anomalies

Clinical Evaluation

Gingival biotype assessment for each subject was performed independently by two examiners. A gingival index was not employed in the present study, in accordance with methodologies adopted by several previous investigators, where gingival biotype evaluation was carried out without the use of a gingival index [4, 10]. The determination of gingival biotype was based on the probe transparency and transgingival probing method. Probing depth was measured in millimetres using a UNC-15 periodontal probe, while gingival recession was recorded and classified according to Miller's classification system.

Gingival Biotype Assessment: Two methods were used:

Probe Transparency Method:

The periodontal probe's visibility through the gingival margin was used to classify gingiva as thin (probe visible) or thick (probe not visible) (Fig-1).

Figure 1: Showing Gingival biotype assessment using probe transparency method

Measurements were obtained using a calibrated and standardized periodontal probe (UNC-15, Hu-Friedy), which was gently inserted through the gingival margin into the sulcus at the mid-facial aspect of both mandibular incisors, as described by Kan *et al.,* [10]. When the contour of the periodontal probe was visible through the gingival tissue, the gingival biotype was classified as thin. In cases where the probe was not visible through the gingiva, the biotype was categorized as thick.

Transgingival Probing:

A No.15 endodontic file with rubber stopper was used to determine gingival thickness in mm at buccal sites. The No. 15 file was inserted perpendicular to the gingival surface at the mid-facial aspect of the selected tooth and gently advanced through the soft tissue until resistance from the underlying alveolar bone was encountered (Fig-2).

Figure 2: Showing Gingival biotype assessment using 15 no. endodontic file by transgingival method

The rubber stopper was adjusted to contact the external gingival surface, and the file was carefully withdrawn. The distance from the tip of the file to the rubber stopper was measured using a calibrated vernier calliper, representing the gingival thickness at that site. Measurements were recorded to the nearest millimetre. Based on the recorded values, gingival thickness was categorized as thin (≤1 mm) or thick (≥2 mm). All measurements were performed under standardized conditions to minimize variability.

RESULTS

Previous studies evaluating gingival biotype have included a wide age range to assess its distribution across different age groups. However, it has been observed that the prevalence of periodontal disease increases with advancing age, and a majority of individuals above 50 years commonly present with chronic periodontitis. Consequently, the proportion of subjects with a clinically healthy periodontium in older age groups is limited.

In order to minimize the influence of periodontal disease as a confounding factor and to ensure accurate assessment of gingival biotype in a healthy periodontium, the present study restricted the study population to individuals aged 20–40 years. This age group represents a period in which periodontal tissues are relatively stable and less likely to be affected by chronic inflammatory changes. Inclusion of systemically and periodontally healthy individuals within this age range allowed for a more reliable evaluation of gingival biotype and its association with periodontal parameters such as probing depth and gingival recession.

A total of 85 mandibular anterior teeth were evaluated in the present study. Tooth-wise distribution showed that mandibular left central incisors (31) constituted 55.3% (n = 47) of the sample, while mandibular right central incisors (41) accounted for 44.7% (n = 38).

Probe transparency was observed in 63.5% (n = 54) of sites, whereas 36.5% (n = 31) did not exhibit probe visibility. Gingival thickness assessment using a No. 15 K-file revealed that 63.5% (n = 54) of sites had a thin gingival phenotype (<1 mm), while 36.5% (n = 31) demonstrated thick gingiva (>1 mm). The mean gingival thickness was 1.36 ± 0.48 mm.

Regarding periodontal parameters, 63.5% (n = 54) of sites exhibited probing depths <3 mm, while 36.5% (n = 31) showed probing depths >3 mm, with a mean probing depth of 1.36 ± 0.48 mm. Gingival recession was present in 55.3% (n = 47) of the sites, with a mean recession score of 1.45 ± 0.50. According to Miller's classification, Class I recession was the most prevalent (47.1%), followed by Class II (5.9%) and Class III (2.4%), while 44.7% of sites showed no recession (Fig 3).

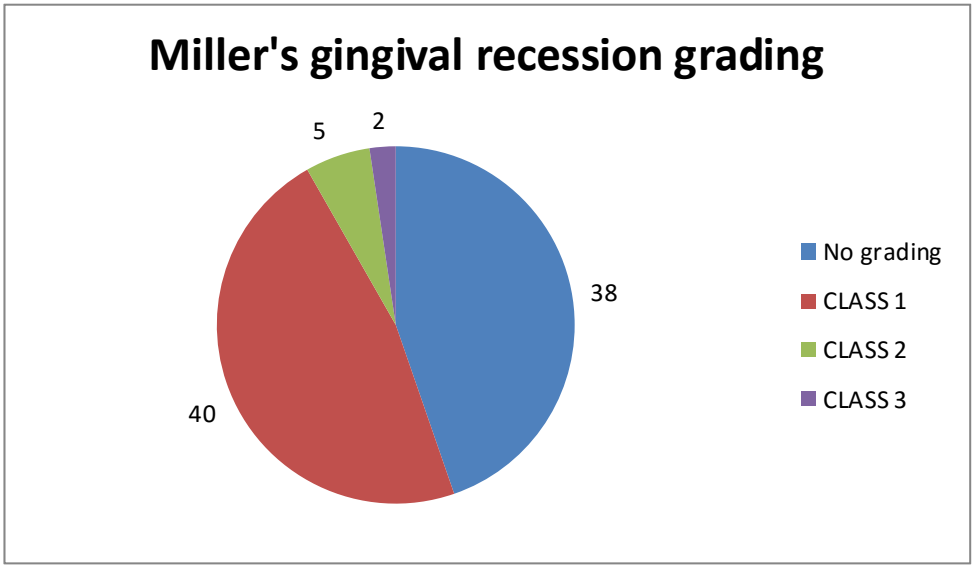

Figure 3: Pie chart illustrating the distribution according to Miller's gingival recession grading

A statistically highly significant association was observed between probe transparency and gingival thickness ($\chi^2 = 9.82$; $p = 0.002$), with probe transparency being more frequently associated with thin gingiva <1 mm (Table 1). Similarly, a highly significant relationship was found between probing depth and gingival thickness ($\chi^2 = 47.319$; $p < 0.001$), where sites with probing depth <3 mm predominantly exhibited a thin gingival phenotype (Table 2).

No statistically significant association was noted between gingival thickness and the presence of gingival recession ($p = 0.155$) or Miller's recession grades ($p = 0.373$) (Table 3). However, a highly significant association was identified between probe transparency and gingival recession ($\chi^2 = 10.475$; $p = 0.001$), with recession being more prevalent at sites demonstrating probe transparency.

Table 1: Shows statistically highly significant difference seen for the frequencies between the Probe transparency (p<0.01) for mean Gingival thickness using 15 no. K file in mm with higher values in Probe transparency seen YES of Gingival thickness <1 mm

		Gingival thickness using 15 no. K file in mm				
		Gingival thickness <1 mm	**Gingival thickness >1 mm**	**Total**	**Chi-Square value**	**P value of Chi-Square test**
Probe transparency seen	YES	41	13	54	9.82	0.002
	NO	13	18	31		
Total		**54**	**31**	**85**		

Table 2: Shows statistically highly significant difference seen for the frequencies between the Probing depth in mm (p<0.01) for mean Gingival thickness using 15 no. K file in mm with higher values in Probing depth in mm <3 mm of Gingival thickness <1 mm

		Gingival thickness using 15 no. K file in mm				
		Gingival thickness <1 mm	**Gingival thickness >1 mm**	**Total**	**Chi-Square value**	**P value of Chi-Square test**
Probing depth in mm	Probing depth <3 mm	49	5	54	47.319	0.000**
	Probing depth > 3 mm	5	26	31		
Total		**54**	**31**	**85**		

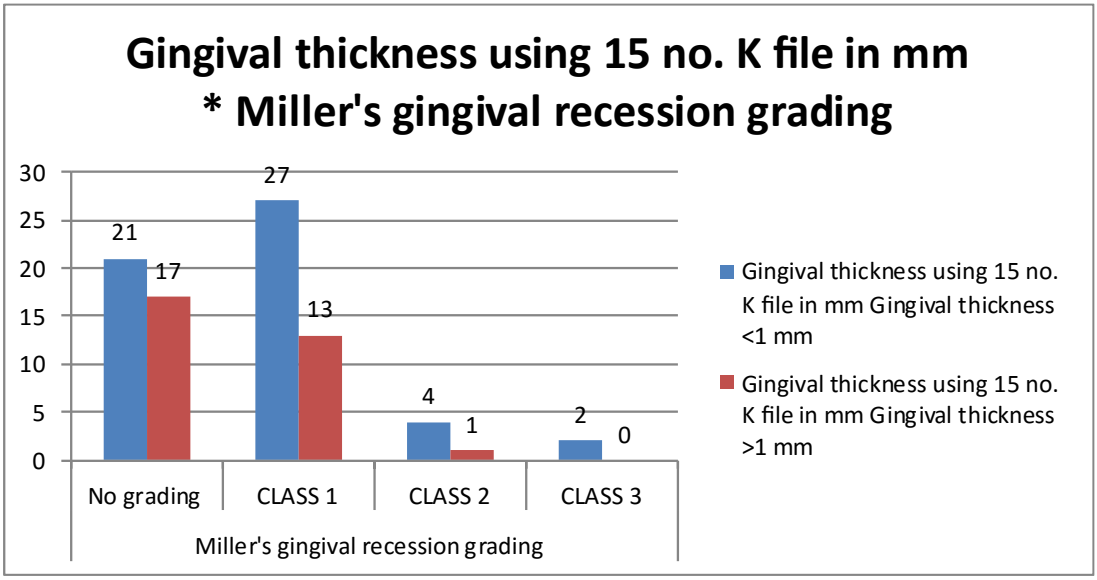

Table 3: Bar chart depicting the distribution of gingival thickness measured using a No. 15 K-file, categorized as <1 mm and >1 mm, across different Miller's gingival recession grades

DISCUSSION

The findings support existing literature that identifies gingival biotype as a critical factor influencing periodontal health. The present study evaluated the relationship between gingival thickness, probe transparency, probing depth, and gingival recession in mandibular anterior teeth and provides clinically relevant insights into gingival phenotype assessment. The high prevalence of thin gingival phenotype (63.5%) observed in this study is consistent with previous reports indicating that mandibular anterior regions commonly exhibit thinner gingival tissues due to anatomical limitations and reduced keratinized tissue width.

Probe transparency was detected in nearly two-thirds of the study population, reinforcing its utility as a simple, non-invasive clinical indicator of gingival thickness. The statistically significant association between probe transparency and thin gingiva observed in the present study supports the findings of Kan *et al.,* [10] who first described probe transparency as a reliable method for gingival phenotype assessment. Similar observations were reported by De Rouck *et al.,* [4] who demonstrated a strong correlation between probe visibility and gingival thickness measurements obtained by direct methods.

The significant association between gingival thickness and probing depth suggests that thinner gingival tissues may be more susceptible to inflammatory changes, even at shallow probing depths.[15] This finding aligns with the biological concept that thin gingival phenotypes possess reduced connective tissue volume and vascular support, making them more prone to inflammatory breakdown.

Several studies underscore the importance of gingival biotype in various clinical outcomes. For instance, Kao and Pasquinelli [1] highlighted that the morphological differences in gingival tissue influence treatment outcomes in periodontal disease and restorative procedures. Their research emphasized the significance of understanding these differences to tailor treatment approaches effectively.

Further, research by Maroso *et al.,* [5] established a correlation between gingival thickness and recession, noting that thinner biotypes were more prone to recession following surgical interventions. This was supported by findings from Singh *et al.,* (2016), who found a positive correlation between gingival thickness and keratinized tissue width, indicating that thicker biotypes may better withstand inflammatory insults.

Interestingly, although gingival recession was more frequently observed in sites with thin gingiva, the association between gingival thickness and recession did not reach statistical significance. This indicates that gingival recession is multifactorial, influenced not only by tissue thickness but also by tooth position, alveolar bone morphology, and mechanical trauma such as tooth brushing. Similar conclusions have been drawn by Kao *et al.,* [13] who emphasized that gingival phenotype alone cannot predict recession development.

The significant relationship between probe transparency and gingival recession observed in this study further supports the concept that probe visibility serves as a surrogate marker for tissue vulnerability. Studies by Seibert and Lindhe [14] have highlighted that thin periodontal tissues are more prone to marginal tissue migration when exposed to inflammatory or mechanical insults.

Overall, the findings of the present study substantiate the clinical relevance of gingival phenotype

assessment using probe transparency and reinforce its role in periodontal diagnosis and treatment planning. Identification of thin gingival phenotypes can aid clinicians in risk assessment for recession and in selecting appropriate preventive and therapeutic strategies.

Limitations of this study include its cross-sectional nature and reliance on a single geographic population, which may limit generalizability. Future research should explore longitudinal multicentric studies and include diverse populations to further validate these findings.

CONCLUSION

Gingival biotype significantly influences periodontal parameters. Understanding this relationship is essential for developing individualized treatment plans in periodontal therapy and ultimately improving patient outcomes. This study reinforces the notion that gingival biotype significantly influences periodontal parameters. This study concludes that thin biotypes are associated with increased probing depths and gingival recession. Assessment of gingival phenotype should be an integral part of periodontal evaluation and personalized treatment strategies.

Conflict of interest- Nil

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