

Evaluation of Gingival Phenotype in Maxillary Central Incisors among Patients Visiting a Tertiary Care Centre of Madhesh Province, Nepal

Dr. Harish Kumar Shah,¹ Dr. Rajesh Shah,¹ Dr. Sujaya Gupta,² Dr. Harendra Mohan Singh,³ Dr. Mohammad Asdaq Hussain,³ Dr. Kaushal Kumar Singh,⁴ Dr. Abanish Singh⁵

¹Department of Periodontology and Oral Implantology, National Medical College Teaching Hospital, Birgunj-15, Parsa, Nepal;

²Department of Periodontics and Oral Implantology, Dental Programme, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal;

³Department of Conservative Dentistry and Endodontics, National Medical College Teaching Hospital, Birgunj-15, Parsa, Nepal;

⁴Department of Orthodontics, National Medical College Teaching Hospital, Birgunj-15, Parsa, Nepal;

⁵Department of Community Dentistry, National Medical College Teaching Hospital, Birgunj-15, Parsa, Nepal.

ABSTRACT

Introduction: Gingival phenotype plays an important role in maintenance of healthy periodontium. Therefore, it is crucial to determine gingival phenotype before any dental related therapy as it helps in decision making process for better prognosis.

Objective: To evaluate the type of gingival phenotypes in maxillary central incisor teeth and also to test possible effects of probing depth, width of keratinised gingiva, age, gender, religion, smoking, and brushing habits on the gingival phenotype among patients.

Methods: This analytical cross-sectional study was conducted in 268 systemically healthy patients aged 20-50 years in the Department of Periodontology and Oral Implantology, National Medical College from 2023 April and 2024 October after institutional ethical approval. Convenience sampling method was utilised. The gingival phenotype was measured via the probe transparency method. The width of the keratinised gingiva and probing depth were measured in nearest millimetre (mm). Chi-square tests and independent t-tests were applied to determine the possible associations between the dependent and independent variables at the 95% confidence level ($p \leq 0.05$).

Results: Out of 268 patients, 167 (62.3%) had thick gingival phenotype while 101 (37.7%) had thin gingival phenotype. The average width of keratinised gingiva of right and left central incisors were 5.17 ± 1.46 mm and 5.34 ± 1.58 mm respectively, whereas average probing depth were 1.62 ± 0.62 mm and 1.70 ± 0.71 mm respectively. Both the mean width of keratinised gingiva and probing depth were significantly different between thin and thick gingival phenotype ($p < 0.001$).

Conclusions: A thicker gingival phenotype was more prevalent in maxillary central incisor teeth. The width of keratinised gingiva was greater in thick than in thin gingival phenotypes. By contrast, greater probing depths were measured for the thick than for thin gingival phenotypes.

Keywords: Gingival phenotype; probing depth; width of keratinised gingiva.

INTRODUCTION

Gingival phenotype constitute gingival thickness and width of the keratinised gingiva.¹ Gingival phenotype influences success of periodontal, restorative, prosthetic, orthodontic, and implant treatment.² In a study conducted among an Eastern Nepali

population, the prevalence of a thin gingival biotype was 41%, whereas that of a thick gingival biotype was 59%.³ In contrast, in a study involving the Dominican adult sample, 59.8% of individuals were thin, and 40.2% had a thick gingival phenotype.⁴

The types of gingival phenotype varies among different areas of population.^{2,5} Data of gingival phenotype from the Madhesh Province of Nepal are sparse and desirable. It is important to collect information from the Madhesh Province to develop an appropriate universal data set of gingival phenotypes in Nepal. Therefore, the objective of this study was to evaluate the type of gingival phenotype in maxillary central incisor teeth and also to test possible effects

Correspondence

Dr. Harish Kumar Shah

Email: harishshah46@yahoo.com



Citation

Shah HK, Shah R, Gupta S, Singh HM, Hussain MA, Singh KK, Singh A. Evaluation of Gingival Phenotype in Maxillary Central Incisors among Patients Visiting a Tertiary Care Centre of Madhesh Province, Nepal. J Nepal Soc Perio Oral Implantol. 2025 Jan-Jun;9(17):1-7.

of probing depth, width of keratinised gingiva, age, gender, religion, smoking and brushing habits on the gingival phenotype.

METHODS

This cross-sectional study was approved by the Institutional Review Committee, National Medical College (NMC) (Reference number: F-NMC/650/079-080). The study was conducted at the Periodontology and Oral Implantology Department, NMC, Birgunj-15, Parsa, Nepal, between 2023 April and 2024 October. All the participants were informed about the details of the study and provided written informed consent. This study was performed in accordance with the Helsinki Declaration of 1975 as revised in 2013 and was reported in compliance with the “strengthening the reporting of observational studies in epidemiology” (STROBE statement).⁶

Two hundred and sixty-eight individuals who fulfilled the inclusion criteria were selected from patients attending the Department of Periodontology and Oral Implantology using convenience sampling. The inclusion criteria for the study were as follows: male or female patients over 18 years of age, healthy gingiva with probing depth ≤ 3 mm, intact fully erupted maxillary incisors, and right and left maxillary central incisors with the same gingival phenotype.

The exclusion criteria were as follows: excessively pigmented marginal gingiva and had undergone surgical intervention or orthodontic therapy in the upper anterior region; pregnant females; sensitivity to Lugol’s iodine solution; maxillary incisor crowding; distinct angulation; filling; prosthetic restoration on the labial surface; taking any medication affecting the gingiva; gingival inflammation and enlargement; and recession and clinical attachment loss.

For sample size calculation, a study performed by Shrestha et al. was considered.³ According to this study, the proportion of thin gingival biotypes was 41.24%. Taking proportion, $p = 41.24\%$, $q = 58.76\%$ and the relative permissible error (l) = 10% of $l = 6.18$.

Using the standard formula, $n = Z^2 * p * q / l^2 = 243.74 \approx 244$ was obtained. To make the findings more reliable, all the participants meeting the inclusion criteria ($N = 268$) were enrolled in this study.

Patient demographics, such as age, sex (male or female), smoking status (yes or no), religion (Hindu or Islam), brushing frequency (once or twice a day), and type of gingival phenotype (thick or thin), were recorded. The gingival phenotype for each of the participants was measured on the basis of the transparency of the periodontal probe through the gingival sulcus (probe transparency method).^{1,7} Examinations were carried out by a single trained and calibrated periodontist.

In this technique, the gingival phenotype was determined with a calibrated and standardised colour-coded periodontal probe. The probe was inserted into the gingival sulcus at the mid labial aspect of the maxillary right and left central incisors. If the periodontal probe was visible through the gingiva, it was categorised as thin; if not visible, it was categorised as thick (Figures 1, 2). To determine the mucogingival junction, Lugol’s iodine solution (2%) was applied to the patient’s upper labial mucogingival junction area. The non-keratinised alveolar mucosa shows an iodo-positive reaction, whereas the keratinised gingival tissue, because of its low glycogen content, shows an iodo-negative reaction. Once the mucogingival junction was located, the width of the keratinised gingiva was determined by using a calibrated and standardised colour-coded periodontal probe from the gingival margin to the mucogingival junction on the right and left maxillary central incisors, respectively. The measurements were recorded to the nearest millimetre (mm) marking.

The collected data were entered into MS Excel Sheet 2019 and transferred into IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA) for analysis. Chi-square tests and independent t-tests were applied to determine the significant associations between the dependent and independent variables at the 95% confidence level ($p \leq 0.05$).



Figure 1: Thick gingival phenotype.



Figure 2: Thin gingival phenotype.

RESULTS

A total of 268 participants aged 20-50 years were included in the present study. The socio-demographic characteristics, including age group, sex, smoking status, and brushing frequency, of the study population have been tabulated (Table 1). Among the 268 patients, 143 (53.4%) were males, and 167 (62.3%) had a thick gingival phenotype (Table 1).

The average widths of the keratinised gingiva of the right and left central incisors were 5.17 ± 1.46 mm

and 5.34 ± 1.58 mm, respectively, whereas the average probing depths were 1.62 ± 0.62 mm and 1.70 ± 0.71 mm, respectively (Table 2).

None of the socio-demographic characteristics of the participants with different gingival phenotypes were found to be statistically significant ($p > 0.05$, Table 3).

Both the mean width of the keratinised gingiva and the probing depth were significantly different between the thin and thick gingival phenotypes ($p < 0.001$, Table 4).

Table 1: Socio-demographic characteristics of participants.

Variables		Frequency (Percent)
Gender	Male	143 (53.4)
	Female	125 (46.6)
Gingival phenotype	Thick	167 (62.3)
	Thin	101 (37.7)
Age category	20-30 years	77 (28.7)
	31-40 years	99 (36.9)
	41-50 years	92 (34.3)
Religion	Hindu	212 (79.1)
	Islam	56 (20.9)
Smoking status	Yes	78 (29.1)
	No	190 (70.9)
Brushing status	Once	178 (66.4)
	Twice	90 (33.6)
Total		268 (100)

Table 2: Width of keratinised gingiva and probing depth.

Variables	Maxillary right central incisors (Mean±SD)	Maxillary left central incisors (Mean±SD)
Average width of keratinised gingiva	5.17±1.456	5.34±1.581
Average width of probing depth	1.62±0.622	1.70±0.710

Table 3: Socio-demographic characteristics of the participants with different gingival phenotype.

Variables		Gingival Phenotype		
		Thick	Thin	p-value
Gender	Male	92	51	0.465
	Female	75	50	
Smoking Status	Yes	50	28	0.699
	No	117	73	
Religion	Hindu	133	79	0.781
	Islam	34	22	
Brushing frequency	Once	112	66	0.773
	Twice	55	35	
Age category	20-30 years	52	26	0.634
	31-40 years	60	40	
	41-50 years	55	35	

*Chi-square test

Table 4: Width of keratinised gingiva and probing depth in different gingival phenotype.

Variables	Gingival phenotype	N	Mean±SD	p-value
Width of keratinised gingiva maxillary right central incisor	Thick	167	5.97±1.026	<0.001
	Thin	101	3.85±1.043	
Width of keratinised gingiva maxillary left central incisor	Thick	167	6.21±1.150	<0.001
	Thin	101	3.89±1.048	
Probing depth maxillary right central incisor	Thick	167	1.85±0.597	<0.001
	Thin	101	1.24±0.451	
Probing depth maxillary left central incisor	Thick	167	1.95±0.701	<0.001
	Thin	101	1.28±0.492	

Independent t-test

DISCUSSION

In aesthetic guided dentistry era, it becomes compulsory to determine soft and hard tissue around the teeth that can impact final aesthetic outcome of dental treatment. The term gingival phenotype was proposed by the “2017 World Workshop on the Classification of Periodontal and

Peri-Implant Diseases and Conditions”.¹ It consists of two components, the gingival thickness and width of keratinised gingiva.¹ Gingival phenotype varies among different individuals in addition to various areas of oral cavity within same individuals.⁵

The assessment of gingival phenotype should be a part of treatment planning and risk evaluation

prior to dental interventions, including soft tissue manipulation particularly in aesthetic zone as it responds differently with surgical therapy, orthodontic treatment, restorative therapy, implant placement, and root coverage procedures.⁸⁻¹²

The present study determines the type of gingival phenotype in maxillary central incisor among patients visiting a tertiary care centre of Madhesh Province, Nepal. In this study, the prevalence of thick gingival phenotype was 167 (62.3%) whereas 101 (37.7%) had thin gingival phenotype. Thus, thicker gingival phenotype was more prevalent than thinner gingival phenotype in maxillary central incisor teeth. This finding is similar to the various other studies from other regions of world.^{3,13-15} In contrast to this study, Collins et al. reported 59.8% had thin gingival phenotype and 40.2% of individuals had thick gingival phenotype in Dominican adults.⁴ The difference might be due to different racial or genetic makeup of studied population.³

In the present study, no significant difference was found between age and gender with type of gingival phenotype. Similar results was seen in previous studies.^{16,17} However, few studies reported statistically significant association between gender and gingival thickness.^{12,18} The difference in findings could be due to differences in sample and racial features.

Several techniques have been used for determination of gingival phenotype including visual evaluation, probe transparency, transgingival probing, ultrasonic devices, and cone beam computed tomography.² The “2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions” recommended to assess the phenotype using probe transparency (TRAN method) in order to categorise phenotype as thin (probe visible, ≤ 1 mm gingival thickness) or thick (probe not visible, > 1 mm gingival thickness).¹ In current study, we have utilised TRAN technique (Probe transparency method) for determining gingival phenotype as it simple, minimally invasive, considering it highly reliable and reproducible.^{7,12} In present study, gingival phenotype was determined in maxillary central incisors as it is most visible teeth influencing aesthetics in oral

cavity, easily accessible for accurate measurement of gingival phenotype.^{3,11}

The present study showed that gingival phenotype is not influenced by religion- Hindu or Islam. To the best of authors’ knowledge, this is the inaugural study comparing the type of gingival phenotype with religion among Nepali population. According to 2021 census Nepal, Hinduism is the most followed religion (83.75%) followed by Islam (12.9%). Similar sample population with 79.1% following Hindu religion and 20.9% following Islam were recruited in this study.

In the current study, gingival phenotypes were not found to be different in either smoker or non-smoker. This result is consistent with the study done by Shrestha et al.³ However, it has been found that nicotine increases the thickness of gingiva.¹⁸ The increase in thickness of gingiva is attributed by histopathological changes such as epithelial hyperplasia, increased keratinisation, and increase vascularity.¹⁹ The difference in findings might be due to inadequate number of smoker in present study. The current study also revealed that gingival phenotype was not significantly associated between one who brushes once or twice daily. This finding is consistent with the other study.³

The present study found that thicker gingival phenotype had wider zone of width of keratinised gingiva compared to thinner gingival phenotype. This result was statistically significant. This finding is in line with previous studies.²⁰⁻²³ In this study, thicker gingival phenotype was found to have statistically significant deeper probing depth than thinner gingival phenotype. Similar result was reported by Olsson et al. and Muller et al.^{24, 25}

Thicker gingival phenotype consists of higher amount of extracellular matrix and collagen which resists contraction and collapse of tissue. Additionally, it contains increase amount of blood vessels helping in tissue oxygenation, boosting immune response, and removal of unwanted toxic products and enhancing healing response. It also prevents physical damage and microbial entry due increase layer of keratinisation. However, thin weaker gingival

phenotype is less resistant to inflammation, trauma or surgical insult and thus usually exhibits highly accentuated, minimum attachment and receded soft tissues.^{2,8}

Madhesh province of Nepal consists of eight districts: Parsa, Bara, Rautahat, Sarlahi, Mahottari, Dhanusha, Siraha, and Saptari.²⁶ Prior to this study, the investigators did not find any other study that had evaluated prevalence of gingival phenotype in maxillary central incisor teeth in Madhesh Province. The results obtained can be utilised as baseline data related to gingival phenotype. However, this is a single centre study. The findings of this study cannot be generalised to the whole population of the Madhesh Province.

CONCLUSIONS

A thicker gingival phenotype was more prevalent in maxillary central incisor teeth. The gingival phenotype does not appear to be influenced by age, sex, religion, smoking status, or brushing frequency. The width of keratinised gingiva was greater in thick than in thin gingival phenotypes. By contrast, greater probing depths were measured for the thick than for thin gingival phenotypes. Further studies should be conducted taking samples from multiple centres of the Madhesh Province.

Conflict of interest: None.

REFERENCES

1. Jepsen S, Caton JG, Albandar JM, et al. Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J Periodontol*. 2018;89(1):S237-48.
2. Shah HK, Sharma S, Shrestha S. Gingival biotype classification, assessment and clinical importance: A review. *J Nepal Soc Perio Oral Implantol*. 2020;4(8):83-8.
3. Shrestha S, Goel K, Niraula SR. Assessment of gingival biotypes in patients visiting a tertiary care centre in eastern Nepal. *J Nepal Health Res Counc*. 2020;18(3):472-7.
4. Collins JR, Pannuti CM, Veras K, et al. Gingival phenotype and its relationship with different clinical parameters: A study in a Dominican adult sample. *Clin Oral Investig*. 2021;25(8):4967-73.
5. Goaslind GD, Robertson PB, Mahan CJ, et al. Thickness of facial gingiva. *J Periodontol*. 1977;48(12):768-71.
6. von Elm E, Altman DG, Egger M, et al.; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. *J Clin Epidemiol*. 2008;61(4):344-9.
7. Kan JY, Morimoto T, Rungcharassaeng K, et al. Gingival biotype assessment in the aesthetic zone: Visual versus direct measurement. *Int J Periodontics Restorative Dent*. 2010;30(3):237-43.
8. Joshi N, Agarwal MC, Madan E, et al. Gingival biotype and gingival bioform: Determining factors for periodontal disease progression and treatment outcome. *Int J Sci Study*. 2016;4(3):220-5.
9. Abraham S, Deepak KT, Ambili R, et al. Gingival biotype and its clinical significance: A review. *Saudi J Dent Res*. 2014;5:3-7.
10. Kim DM, Bassir SH, Nguyen TT. Effect of gingival phenotype on the maintenance of periodontal health: An American Academy of Periodontology best evidence review. *J Periodontol*. 2020;91(3):311-38.
11. Moosa Y, Samaranayake L, Pisarnurakit PP. The gingival phenotypes and related clinical periodontal parameters in a cohort of Pakistani young adults. *Heliyon*. 2024;10(2):e24219.
12. De Rouck T, Eghbali R, Collis K, et al. 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):428-33.
13. Shao Y, Yin L, Gu J, et al. Assessment of periodontal biotype in a young Chinese population using different measurement methods. *Sci Rep*. 2018;8(1):11212.
14. Zhang Y, Chen F, Kang N, et al. Clinical and computed tomographic evaluations of periodontal phenotypes in a Chinese population: A cross-sectional study. *Clin Oral Investig*. 2023;27(7):3569-77.
15. da Costa FA, Perussolo J, Dias DR, et al. Identification of thin and thick gingival phenotypes by two transparency methods: A diagnostic accuracy study. *J Periodontol*. 2023;94(5):673-82.
16. Eger T, Müller HP, Heinecke A. Ultrasonic determination of gingival thickness. Subject variation and influence of tooth type and clinical features. *J Clin Periodontol*. 1996;23(9):839-45.
17. Cook DR, Mealey BL, Verrett RG, et al. Relationship between clinical periodontal biotype and labial plate thickness: An in vivo study. *Int J Periodontics Restorative Dent*. 2011 Jul-Aug;31(4):345-54.
18. Kolte R, Kolte A, Mahajan A. Assessment of gingival thickness with regards to age, gender, and arch location. *J Indian Soc Periodontol*. 2014;18(4):478-81.
19. Vandana KL, Savitha B. Thickness of gingiva in association with age, gender, and dental arch location. *J Clin Periodontol*. 2005;32(7):828-30.
20. Müller HP, Eger T. Gingival phenotypes in young male adults. *J Clin Periodontol*. 1997;24(1):65-71.

-
21. Egreja AM, Kahn S, Barceiro M, et al. Relationship between the width of the zone of keratinised tissue and thickness of gingival tissue in the anterior maxilla. *Int J Periodontics Restorative Dent*. 2012;32(5):573-9.
 22. Shah R, Sowmya NK, Mehta DS. Prevalence of gingival biotype and its relationship to clinical parameters. *Contemp Clin Dent*. 2015;6(Suppl 1):S167-71.
 23. Fischer KR, Künzlberger A, Donos N, et al. Gingival biotype revisited-novel classification and assessment tool. *Clin Oral Investig*. 2018;22(1):443-48.
 24. Olsson M, Lindhe J, Marinello CP. On the relationship between crown form and clinical features of the gingiva in adolescents. *J Clin Periodontol*. 1993;20(8):570-7.
 25. Müller HP, Könönen E. Variance components of gingival thickness. *J Periodontal Res*. 2005;40(3):239-44.
 26. Hussain MA, Singh SK, Naz S, et al. Predictors of apical periodontitis in root canal treated teeth from an adult Nepalese subpopulation: A cross-sectional study. *BMC Oral Health*. 2024;24(1):400.
-