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Prevalence and Associated Factors of Gingival Pigmentation

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ABSTRACT

Background: While dentistry in the past focused primarily on prevention and treatment of dental diseases, modern dentistry has evolved to place greater emphasis on appearance of teeth, gums, and the overall smile. Since gingival pigmentation significantly impacts a patient's aesthetics, it has recently become a prominent topic of interest. Objective was to determine the prevalence of gingival pigmentation among Nepalese people in terms of its extent and distribution and to correlate it with age, gender, and gingival biotype.

Methods: This cross-sectional analytical study was conducted on Nepalese patients who visited the 'Department of Periodontology and Oral Implantology' at Dhulikhel Hospital from June 20, 2024 to September 20, 2024 after obtaining ethical approval. Data was collected via convenience sampling, and intraoral examinations focused on gingival biotype and pigmentation in the anterior labial region, a key aesthetic area. The data was entered into MS EXCEL and analyzed using the latest version of SPSS.

Results: Total 380 patients were examined in this study, including 173 (45.5%) males and 207(54.5%) females. Most had pigmentation in the attached gingiva followed by interdental papillae. There was a statistically significant relationship ($p<0.05$) between gingival pigmentation and the patient' age, as well as between gingival pigmentation and gingival biotype ($p<0.05$) However, there was no significant relationship ($p=0.59$) between gingival pigmentation and the patient's gender.

Conclusions: Knowledge regarding the distribution and extent of gingival pigmentation will be a valuable asset for clinicians during various depigmentation procedures, to choose the most appropriate technique for a particular type of gingival pigmentation.

Keywords: Depigmentation; gingiva; gingival biotype; gingival pigmentation.

INTRODUCTION

The gingiva, part of the masticatory mucosa, covers the alveolar process and surrounds the tooth's cervical area. Its "coral pink" color is due to vascular supply, epithelial thickness, keratinization, and pigment-containing cells.[1]

Oral pigmentation in black individuals is seen in the gingiva(60%), hard palate(61%), mucous membrane(22%), and tongue(15%).[2] Gingival pigmentation can appear as early as three hours after birth, showing as purplish discoloration or brown patches.[2] However, Prinz noted it typically becomes visible after puberty and fades with age.[3] Today, people seek dental care for aesthetic reasons beyond teeth whitening, including the natural coral-pink color of the gingiva.

Recent research in Nepal found that gingival pigmentation is more common in thick biotypes, especially on attached gingiva. No significant link was observed between pigmentation and gender.[4] While evidence supporting past findings is limited, this study highlights the relationship between gingival pigmentation, age, gender, and biotype, aiding clinicians in selecting appropriate perioplastic surgery.

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METHODS

A cross-sectional analytical study was carried out on all Nepalese patients visiting the Department of Periodontology and Oral Implantology in Kathmandu University School of Medical Sciences-Dhulikhel Hospital (KUSMS-DH) Dhulikhel, Bagmati province during the period of June 20, 2024 to September 20, 2024 after getting ethical approval from the institutional review committee of KUSMS (IRC-KUSMS Ref: 170/24, Date of approval : 17th June 2024).

All patients above the age of 18 who visited the Department of Periodontology and Oral Implantology at Dhulikhel Hospital and agreed to sign an informed consent form to participate in the study met the inclusion criteria of this study. Patients under 18 were excluded from this study as they were incapable of comprehending its purpose. Additionally, those unwilling to provide written consent after verbal explanation, those with systemic diseases leading to gingival pigmentation (e.g., Peutz-Jeghers Syndrome, Addison's Disease), and individuals with gingival disease affecting gingival architecture were not eligible. Furthermore, patients who smoked or had experienced chemicalburns and peeling of the epithelium were also deemed unsuitable.

According to a study done by Rijal et al,[4] the maximum prevalence of gingival pigmentation was 54.8 %, so by taking this reference, we calculated the sample size for our study as follows: n= $(1.96)^2$ X 54.8 X (100- 54.8)/ 5^2= 380.6 = 380

Convenience sampling technique was used and samples were collected using a data information sheet (proforma). Invitations to participate in the research were given to individuals attending the Department of Periodontology and Oral Implantology at KUSMS. Interested individuals were required to sign an informed consent form to participate in the study. Two trained examiners completed periodontal examinations for all subjects. Inter-examiner reliability was calculated using Cohen's kappa value which was 0.85. The status of gingival pigmentation in patients was assessed through visual examination of the anterior esthetic region of the gingiva using a mouth mirror to retract the lips.

Dummett-Gupta Oral Pigmentation Index and Ponnaiyan et al. classification was used to examine and classify the gingival pigmentation regarding its distribution and extent respectively.

Dummett-Gupta Oral Pigmentation Index[2]

0 = Pink tissue (no clinical pigmentation)

1 = Mild, light brown tissue (mild clinical pigmentation)

2 = Medium brown or mixed pink or brown tissue (moderate clinical pigmentation)

3 = Deep brown or blue/black tissue (heavy clinical pigmentation)

Ponnaiyan et al.[5]

Class I – Pigmentation in the attached gingiva only

Class II – Pigmentation in attached gingiva and interdental papilla

Class III – Diffuse pigmentation involving all parts of the gingiva

Class IV – Pigmentation in marginal gingiva only

Class V – Pigmentation in interdental papilla only

Class VI – Pigmentation in marginal gingiva and interdental papilla

Gingival biotype was measured using the Probe Transparency Method. Periodontal probing was conducted on the anterior teeth, and the marginal gingiva was slightly raised; if the probe was visible, it was classified as thin, and if it was not, it was classified as thick.[6]

Data was entered into MS Excel and analyzed using V21 of SPSS of SPSS software. Descriptive statistics summarized the data, and the proportion and mean values for various parameters were evaluated. The Chi-square test was used to determine the relationship of gingival pigmentation with gingival biotype, age, and gender.

RESULTS

A total of 380 patients were examined in this study among which, 173(45.5%) were males and 207(54.5%) were females. The mean age of participants was 35.69+14.15 years, the minimum age recorded was 18 years and the maximum was 79 years. Among 380 participants, 173(45.5%) were Brahmin/Chhetri, 109(28.7%) were Newar, 51(13.4%) were Janajati, 22 (5.8%) were Tarai/ Madhesi Other Castes, 22(5.8%) were Dalits, and 3(0.8%) were Muslim. Moreover, 332(87.4%)

out of 380 participants followed Hinduism as their religion, whereas 31(8.2%) followed Buddhism, 13(3.4%) followed Christianity, 3(0.8%) followed Muslim, and 1(0.3%) followed other religions.

It was seen that there was more prevalence of the thick gingival biotype (240, 63.2%) than the thin gingival biotype (140, 36.8%). Considering the extent of gingival pigmentation, out of 380 participants, 144 (37.9%) had no pigmentation at all, 150 (39.5%) had mild, light brown tissue, 62 (16.3%) had medium brown or mixed pink or brown tissue, 24 (6.3%) had deep brown or blue/ black tissue. This classification was based on the Dummett-Gupta Oral Pigmentation Index and is presented as a pie chart in Figure 1.

Additionally, the distribution of gingival pigmentation based on Ponnaiyan et al 2013 classification is represented as a bar diagram in Figure 2. It shows that among 380 participants, 144(37.9%) had no pigmentation, 117(30.8 %) had pigmentation in attached gingiva only, 62(16.3%) had diffuse pigmentation involving all parts of gingiva, 39(10.3%) had pigmentation in attached gingiva and interdental papilla, 10(2.6 %) had pigmentation in marginal gingiva only, 6(1.6%) had pigmentation in marginal gingiva and interdental papilla, and 2(0.5%) had pigmentation in interdental papilla only.

Furthermore, the association between the extent of gingival pigmentation with age, gender, and gingival biotype was determined using a Chi-square test. There was a statistically significant relationship p<0.05) between gingival pigmentation and the age of the patients, as well as between gingival pigmentation and gingival biotype (p=0.004), as shown in Table 1 and Table 2, respectively. However, there was no significant relationship (p=0.59) between gingival pigmentation and the patient's gender (Table 3).

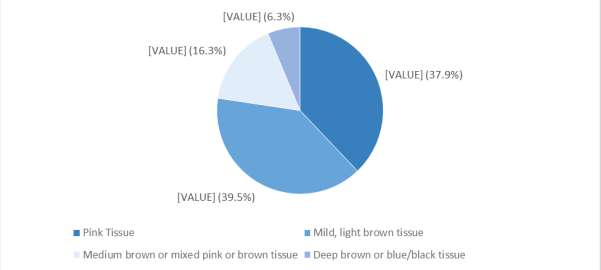

Figure 1. Extent of Gingival Pigmentation.

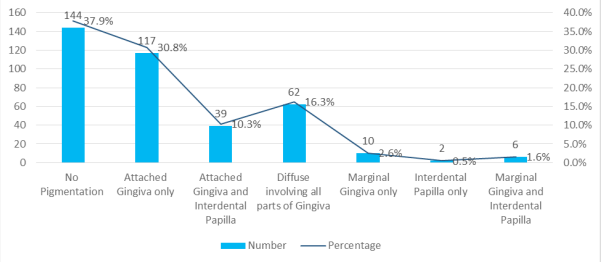

Figure 2. Distribution of Gingival Pigmentation.

Table 1. Association of gingival Pigmentation with age of the patient.

Extent of Pigmentation	Age Group							Total	p-value
	< 20	21-30	31-40	41-50	51-60	61-70	71-80	n (%)	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Pink tissue	10 (30.3)	25 (18.7)	37 (41.6)	31 (59.6)	27 (57.4)	10 (52.6)	4 (66.7)	144 (37.9)	<0.001
Mild	11 (33.3)	64 (47.8)	38 (42.7)	16 (30.8)	15 (31.9)	5 (26.3)	1 (16.7)	150 (39.5)	
Moderate	7 (21.2)	31 (23.1)	11 (12.4)	4 (7.7)	4 (8.5)	4 (21.1)	1 (16.7)	62 (16.3)	
Heavy	5 (15.2)	14 (10.4)	3 (3.4)	1 (1.9)	1 (2.1)	0 (0.0)	0 (0.0)	24 (6.3)	
Total	33 (100)	134 (100)	89 (100)	52 (100)	47 (100)	19 (100)	6 (100)	380 (100)	

Table 2. Association of gingival Pigmentation with gingival biotype.

Extent of Pigmentation	Gingival Biotype		Total	p-value
	Thick	Thin	n (%)	
	n (%)	n (%)		
Pink tissue	76(31.7)	68(48.6)	144(37.9)	0.004
Mild	99(41.3)	51(36.4)	150(39.5)	
Moderate	46(19.2)	16(11.4)	62(16.3)	
Heavy	19(7.9)	5(3.6)	24(6.3)	
Total	240(100)	140(100)	380(100)	

Table 3. Association of gingival Pigmentation with patient's gender.

Extent of Pigmentation	Patient's Gender		Total	p-value
	Male	Female	n (%)	
	n (%)	n (%)		
Pink tissue	64(37.0)	80(38.6)	144(37.9)	0.59
Mild	72(41.6)	78(37.7)	150(39.5)	
Moderate	29(16.8)	33(15.9)	62(16.3)	
Heavy	8(4.6)	16(7.7)	24(6.3)	
Total	173(100)	207(100)	380(100)	

DISCUSSION

Melanin, a derivative of tyrosine, is a polymer made up of polyacetylene, polypyrrole, and polyalanine. It plays a key role in the normal physiological pigmentation of the oral cavity. The pigmentation can appear as diffuse or irregular patterns, varying in color from light brown to dark brown and even black.[7] Gingival pigmentation causes a wide range of aesthetic issues in people. Management of gingival pigmentation is an important factor to be considered to gain patient satisfaction regarding their esthetics, especially in patients with gummy smiles.[8]

The esthetics of intraoral soft tissue have become increasingly important in dentistry, compelling clinicians to achieve satisfactory gingival esthetics. With the growing demand for esthetic improvements, various procedures, including gingivectomy, gingivoplasty, connective tissue grafting, and guided tissue regeneration, are now commonly performed to enhance gingival esthetics.[9] Although the color of the gingiva is crucial to overall esthetics, the principles and techniques for managing issues related to gingival melanin pigmentation (GMP) have yet to be fully established.[9] The proper knowledge and understanding of the extent and distribution of gingival pigmentation is necessary to get an idea of the most appropriate depigmentation procedure for a particular individual.[8]

This study assessed the prevalence of physiological gingival pigmentation and its correlation with age, gender, and gingival biotype in Nepalese patients visiting Dhulikhel Hospital, Dental Department.

In this study, it was found that the majority of the population (117, 30.8%) had gingival pigmentation in attached gingiva only (Class I) which agrees with the study done by Rijal et. al.,[4] Balaji et al.,[10] and Israeli Jewish Population Study[11]. This contrasts with the South African Bantu Population Study[12] and Indian Population study[13], where they found interdental papillae only (Class V) and attached gingiva and interdental papillae (Class II) to be the most common pigmented sites respectively. This variation is thought to be because of differences in the race of the study population.

Furthermore, this study observed that there was a maximum prevalence of mild, light brown pigmentation (150,39.5%), not considering the people with no pigmentation at all, and the least prevalence of deep brown or blue/black pigmentation (24,6.3%), similar to the results obtained from previous studies. [4, 13]

When deciding the aesthetic and functional outcome of periodontal, restorative, and orthodontic therapies, gingival thickness is a crucial factor. Therefore, it has a significant impact and is necessary to achieve the best possible therapeutic results.[14] While comparing

the prevalence of thick and thin gingival biotypes, the thick gingival biotype was more common than the thin one, which matches the results drawn from research done in other parts of Nepal[4] and India[15]. According to the study's findings, there is a statistically significant correlationp<0.05 between gingival biotype and the extent of gingival pigmentation, which is similar to the study done by Radhika et al.,[14] Balaji et al.,[10] and Rijal et al.[4] However, in the study done by Ponnaiyan et al.[5], Rakhewar et al.,[13] and Sriram et al.,[16] there was no significant correlation between the gingival biotype and the intensity of gingival pigmentation.

Moreover, the gingival pigmentation was correlated with the gender of the patient in this study which showed no significant correlation (p=0.59) between the two. This finding is consistent with previous studies conducted on other racial groups.[4, 5, 10, 17, 18] Additionally, a significant correlation was observed between gingival pigmentation and the patient's age ($p < 0.001$). Adequate studies were not found in the literature review linking gingival pigmentation to patient age. Therefore, meaningful comparisons are currently limited.

Although gingival pigmentation is physiological and does not harm the oral mucosa, it has become a growing concern due to its impact on patient aesthetics. Modern patients increasingly value not only the whiteness of their teeth but also the appearance of their gingiva, considering pink gingiva an essential component of an attractive smile. Consequently, clinicians are focusing more on various depigmentation procedures and exploring novel techniques to address this aesthetic concern. Conventional surgical correction, bur abrasion, laser, cryosurgery, and electrosurgery are some of the treatment modalities used by clinicians.[19-21] Understanding the pattern of gingival pigmentation and its correlation with factors such as age, gender, and gingival biotype is crucial. This research will provide valuable insights for clinicians, enabling them to tailor depigmentation procedures to the specific pigmentation patterns of individual patients, thereby enhancing aesthetic outcomes and patient satisfaction. Since this is cross-sectional study carried out in the single hospital setup, that is why it cannot be generalized in the entire population. Longitudinal study with large sample size would improve the quality of the study.

CONCLUSIONS

In light of the evidence presented, it is clear that the majority of the population has melanin pigmentation in the attached gingiva followed by interdental gingiva, with mild, light brown tissue being the most common type of gingival pigmentation. The gender of the patient is not linked with the gingival pigmentation's prevalence. The age of the patient is significantly related to gingival pigmentation but thorough expertise regarding this relationship is yet to be discovered through similar research. The thick gingival phenotype is more prevalent than the thin one and is often associated with gingival pigmentation. This research highlights the relationship between gingival pigmentation, age, gender, and gingival biotype, guiding clinicians in selecting the appropriate perioplastic surgery for different gingival types.

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CONFLICT OF INTEREST

None.

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