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Correlation of Gingival Biotype with Varying Forms of Maxillary Central Incisor

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ABSTRACT

Introduction: Various factors determine the morphological characteristics of gingiva, which plays an important role in the final aesthetic outcome. Gingival biotype is described as a buccolingual dimensions of the gingiva.

Objective: The aim of the study was to find the correlation between gingival biotypes and tooth forms.

Methods: This analytical cross-sectional study was done in 360 patients visiting Department of Dental Surgery, Bir Hospital. The data collection was done from 2020 February to 2021 January using convenience sampling technique. All the parameters were assessed and recorded. The crown width/crown length ratio determined the tooth form. The gingival biotype was classified as thin and thick and was measured by the method of transparency of periodontal probe. Data were analysed using SPSS software v.26.

Results: The result showed that thick gingival biotype was seen in 254 (70.6%) and 106 (29.4%) participants had thin gingival biotype. Square tooth form was most common (256, 71.1%), followed by ovoid (68, 18.9%), and tapered tooth form (36, 10.0%). Thick gingival biotype was seen more than thin gingival biotype among total square, ovoid, and tapered tooth form compared to thin gingival biotype which was not statistically significant (p-value = 0.060).

Conclusions: Within the limitation of the study, it was concluded that there was no correlation between gingival biotype and tooth form.

Keywords: Aesthetics; crown length; crown width; gingival biotype; periodontal probe; tooth form.

INTRODUCTION

Various factors determine the morphological characteristics of gingiva, which play important role in determining the final aesthetic outcome.[1] Gingival biotype is described as the buccolingual dimension of the gingiva. Two main types are: thick and thin gingival biotype. Thick biotype consists of flat, dense, and fibrotic zone of attachment and thick bony architecture, related to a square tooth form which is more resistant to gingival recession whereas thin biotype is highly scalloped, delicate with thin bony architecture, which is more prone to recession, bleeding, and inflammation.[2-4]

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Several methods have been described to determine the gingival thickness: direct measurement, ultrasonic device, cone beam computed tomography, and probe transparency through free gingiva. Visual inspection of transparency of the periodontal probe through the sulcus is the most frequently used method for differentiation of thin and thick biotypes.[5-9]

The previous studies have shown that there is thin gingival biotype associated with tapered tooth form and thick biotype with square form, however some studies did not show the correlation between tooth form and biotype.[10-14] There is paucity of such data in Nepali population, so the aim of this study was to find out correlation between gingival biotypes and tooth forms in the study population.

METHODS

An analytical cross-sectional study was conducted in patients attending the Department of Dental Surgery, Bir Hospital, National Academy of Medical Sciences. Ethical approval was obtained from the Institutional

Review Board, the Ethical Committee of Bir Hospital, National Academy of Medical Sciences (Ref. 1076/076/077; Dated January 28, 2020). Informed consent was obtained from patients recruited by convenience sampling.

A minimum sample size of 341 sample size was calculated using this formula: $n = Z^2 pq/d^2$; Where Z = 1.96 at 95% confidence level; p = 0.53 (53%; proportion of thick gingival biotype);[11] q = 100-p = 0.47 (47%); d = 10% of p. Thus, $n = [(1.96)^2 \times 0.47 \times 0.53] \div (5.3)^2 = 340.7 \approx 341$. However data collection was done in 360 patients from 2020 February to 2021 January. For the evaluation of healthy periodontium, the parameters measured were Plaque Index and Gingival Index and they were assessed and recorded in proforma.

All the patients with healthy periodontal tissues above 18 years attending the Periodontology and Oral Implantology Unit, Department of Dental Surgery, Bir Hospital, National Academy of Medical Sciences who gave informed consent were included in the study. Patients with systemic diseases and medications that are known to affect the periodontium; periodontal diseases (gingivitis, periodontitis, endodontic-periodontic lesion, gingival recession); crown, restoration, prosthesis, attrition, abrasion of maxillary central incisors, and orthodontic treatment were excluded.

Crown width (CW) and crown length (CL) were measured and Crown width/crown length ratio (CW/CL) of the right central incisor was determined. Assessments of width and length was recorded using the divider and the metallic scale. The crown length (apico-coronal distance of the tooth) was measured between the incisal edge of the crown and the gingival zenith, or if discernible, the cementoenamel junction. Crown width is the distance between the approximal tooth surfaces, and it was recorded at the junction between the middle and the cervical portion.[12]

The CW/CL ratio determined the tooth shape. The tooth shapes are most prominent in the cervical 1/3rd of the tooth than in any other part, thus, many previous researchers used CW/CL when studying tooth shape. The group that had a small CW/CL value (<0.66) was classified as taper type, while the group with a large CW/CL value (>0.79) was classified as square type, and the group with an intermediate CW/CL value (0.67-0.76) was classified as ovoid type.[13]

The gingival biotype was classified as thin and thick and was measured by the method of transparency of probe using University of North Carolina-15 (UNC-15) periodontal probe (Hu-Friedy, Chicago, IL, USA) at the two central incisors. Transparency was evaluated through the gingival margin while probing the sulcus at the midfacial aspect. In case the probe was detectable through the tissue, the gingival biotype was categorised as "thin". No visibility of the probe through the marginal gingiva was defined as "thick".[15]

IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA) software was used for the analysis of the data. Pearson's correlation coefficient and independent t-test was used to analyse the relation between the gingival biotype and tooth form.

RESULTS

A total of 360 patients were included in the study with a mean age of 36.51± 13.76 years. In total, 168 (46.7%) were male and 192 (53.3%) were female participants. The mean crown width of central incisor was 7.99±1.07 mm with minimum 5.5 mm and maximum 12.0 mm crown widths, and the mean crown length was 9.38±1.21 mm with minimum 6.0 mm and maximum 12.0 mm crown lengths. It was observed that the square tooth form was most common and least common was tapered tooth form; and thick biotype was most common compared to thin gingival biotype (Tables 1, 2). Among 168 male, 128 (76.2%) had thick gingival biotype and 40 (23.8%) had thin gingival biotype, similarly among 192 female, 126 (65.6%) had thick gingival biotype whereas 66 (34.4%) had thin gingival biotype, which showed statistically significant difference (p-value = 0.019). In relation to tooth form, among 168 males, tapered was seen in 18, ovoid in 28 and square in 122 males respectively, and among 192 females, 18 had tapered tooth form, 40 ovoid and 134 square tooth form. Thick gingival biotype (73.8%) was seen more than the thin gingival biotype (26.2%) among total square tooth form, also in the ovoid tooth form thick gingival biotype (61.8%) was seen more than the thin gingival biotype (38.2%) and tapered tooth form 63.9% had thick gingival biotype and 36.1% had thin gingival biotype. Correlation between the gingival biotype and the tooth form are tabulated and plotted (Table 1, Figure 1). The p-value was calculated to be 0.060, which was not statistically significant.

Table 1: Distribution of gingival biotype and tooth form.

		Gingival biotype, n (%)		Total	p-value
		Thick	Thin		
Tooth form	Tapered	23 (63.9)	13 (36.1)	36	0.060
	Ovoid	42 (61.8)	26 (38.2)	68	
	Square	189 (73.8)	67 (26.2)	256	
Total		254 (70.6)	106 (29.4)	360	

Table 2: Distribution of tooth form.

Tooth form	n (%)
Tapered	36 (10.0)
Ovoid	68 (18.9)
Square	256 (71.1)
Total	360 (100)

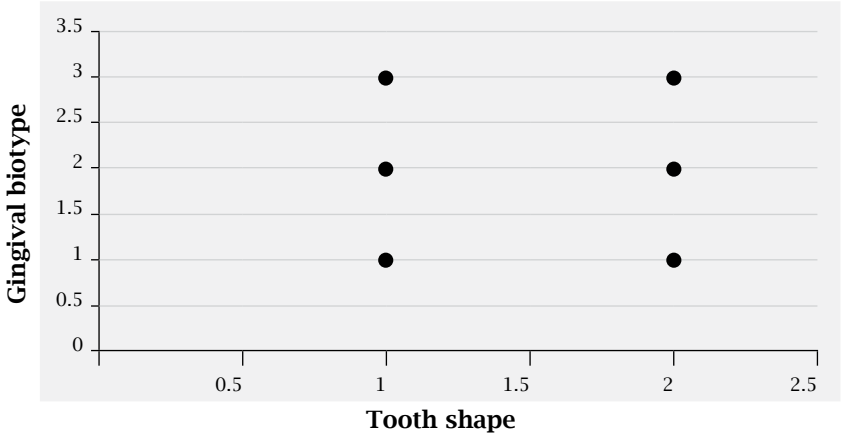

Figure 1: Scatterplot diagram showing correlation of gingival biotype and tooth form.

DISCUSSION

The present study analysed the tooth form and gingival biotype and their correlation, which are useful criteria for the diagnosis and treatment planning especially in the aesthetic zone. It is also important to achieve patient satisfaction by providing information regarding the aesthetic outcomes. The present study showed statistically non-significant correlation between the gingival biotype and tooth form. Thick gingival biotype was the most common compared to that of thin gingival biotype. Among the three different tooth forms, square tooth form was the most common followed by tapered and triangular tooth forms, which was the least common. Thick gingival biotype was seen more in all the tooth form compared to thin gingival biotype, however the correlation between gingival biotype and tooth form was not seen in the present study.

Gingival biotype is one of the critical factors that determine the result of dental treatment. Different gingival biotypes respond differently to parafunctional habits, trauma, and inflammation.[14] Differentiating the types of gingival biotype and its correlation with the tooth form helps to increase the predictability of reconstructive periodontal and peri-implant therapies and helps in the aesthetical outcome and is the very crucial part of the treatment plan as in the thin biotype recession is common.[5] The thicker biotype prevents mucosal recession, hides the restorative margins and camouflages the titanium implant shadows. It also prevents biological seal around implants, thus reducing the crestal bone

resorption.[4] The authors had considered that long tapering teeth having thinner gingival biotype were more susceptible to gingival recession compared to square teeth, furthermore, a study also reported that there is supportive evidence that thin and narrow gingiva tend to have more gingival recession compared to thick and wide biotype.[16] A systematic review had also reported the detrimental effects of orthodontic therapy in periodontium specially in patients with thin biotype.[17]

Periodontal biotypes were introduced by Seibert and Lindhe, who reported the difference between tooth shape and length with the morphology of the bone and gingival tissues. Later, Muller and Eger proposed the term "periodontal phenotypes".[3] Periodontal biotype are the morphological characteristics of the gingiva and periodontium which are partly related to the alveolar process, shape of the teeth, events occurring during the eruption of teeth, inclination, and position of the teeth.[16] Olsson and Lindhe had studied the relationship between tooth form and gingival biotype and reported that long narrow tooth form had thinner biotype than a short-wide tooth form and had experienced more recession.[6] Claffey and Shanley defined thin biotype with not more than 1.5 mm thickness and thick biotype with more than 2 mm.[18]

Different techniques have been used to assess the gingival biotype. Transparency of the probe for the determination of thickness of the gingival biotype was the simple, minimally invasive, and most frequently used method as presented in a previous study.[6] Probe transparency method for determining thickness of gingiva is an accurate and simple method.[9] World Workshop on the Periodontal and Peri-implant Diseases and Conditions has also recommended the probe transparency method for assessing the gingival biotype: probe will be visible when gingival biotype is thin (≤1 mm) and not visible when thick gingival biotype (>1 mm) is present.[7] Transparency of the probe could analyse the gingival thickness qualitatively.[8] So, the probe transparency method was used for the evaluation of the gingival thickness in the present study. De Rouck et al. (2009) also used probe transparency method for determination of thick or thin gingival biotypes as in the present study.[12]

Tooth proportion was determined by CW/CL ratio and was classified as square (CW/CL ratio >0.79), tapered (CW/CL ratio <0.66) and ovoid (CW/CL ratio 0.67-0.76).[13] Tooth forms are very important for the restorative dentistry and are useful for the desirable treatment outcome. In the present study 256 (71.1%) of total subjects had square form of tooth, 68 (18.9%) had ovoid, and 36 (10.0%) had tapered form of tooth. Gobbata et al. (2012) had shown that square tooth form are more common compared to other tooth forms.[14] Furthermore, Barakat et al. (2016) also showed predominant square form of tooth, but they determined shape with a visual inspection taking digital photographs, which might have led to subjective variations.[19] The findings of the study done by Nichani et al. (2016) and Nik-Azis et al. (2024) were in contrast which showed higher percentage of triangular tooth form compared to other forms, however they have used contact surface and crown length ratio for the determination of tooth shape.[20,21] In contrast, Melo et al. (2020) and Nold et al. (2014) in their studies, have documented the higher prevalence of an ovoid tooth shape.[22,23]

Male exhibited higher proportion of square tooth form (72.61%) and lesser ovoid form (16.66%) compared to female (square-69.79%, ovoid-20.83%), which was supported by a study done by Barakat and Dayoub, that showed similar result.[19] In contrast to the present study, Brunetto et al. (2011) showed that women had more prevalent square shape than male.[24] Another contrasting study showed that oval tooth shape was most prevalent in both genders and men had higher triangular form compared to female patients, however in the present study software was not used to determine the tooth shape.[25] Determination of the teeth form is important for the aesthetic restorative success, which is useful guidelines for the periodontal and implant therapy especially in maxillary anteriors to enhance smile and overall patient's satisfaction.[26]

The present study had shown that thick gingival biotype was more common in all three-tooth forms however no correlation was seen between gingival biotype and tooth form which was in contrast to the study done by De Rouck et al. (2009) which reported statistically significant association between the square tooth form and thick gingival biotype while triangular tooth form with thin gingival biotype.[12] The study was supported by the studies done by

Fischer et al. (2014) and Cook et al. (2011) where they had shown non-significant relation between gingival biotypes and tooth forms, however, they had also seen other variables which was not included in the present study.[15,27]

In the present study, thick biotype was more common in male patients compared to females, which was supported by the studies done by Barakat and Dayoub (2016) and Couso-Queirruga et al. (2023).[19,28] Whereas, Sharma et al. (2023) showed that the prevalence of thick gingival biotype was more in females compared to male patients, which was opposite to the findings of present study.[29] In another study, authors reported thick gingiva in about 2/3rd of males and showed association between thick gingiva and slender teeth, which was not consistent with the present study which showed that thick gingiva was seen in 128 (76.2%) male and 126 (65.6%) female, and no association was seen between tooth forms and gingival biotype.[12]

The limitations of the present study are: limited sample size and lack of digital caliper usage. Measurement of the length and width of the incisor could have been more accurate with the digital caliper.

CONCLUSIONS

The gingival biotype and tooth form had no statistically significant correlation in the current study. However, thick gingival biotype was seen more commonly in all three tooth forms compared to thin gingival biotype and males exhibited thicker biotype than females. Further studies are recommended to find the correlation between the gingival biotype and the tooth form.

Conflict of interest: None.

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