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Relationship of Gingival Biotype with Angle`s Malocclusion and Incisor Inclination

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Abstract

Introduction: Gingival biotype can compromise the treatment biomechanics and thus the treatment outcome in perspective of aesthetics, stability and relapse tendency. Prior understanding of gingival biotype might help to modify biomechanics, gingival thickness and tooth movement type in an attempt to provide successful patient care. Therefore, this study's goal is to assess the association between gingival biotype and with various dental malocclusions and maxillary and mandibular incisors inclination.

Methodology: According to the WHO sample size calculator, 156 participants were inducted in this investigation. Following that, three groups of subjects were established: I, II, and III in accordance with Angle`s malocclusion directives. Using a standardized periodontal probe, gingival thickness was gauged for both the upper and lower central incisors. There were two classifications for the gingival biotype: thick and thin. Visibility of the probe through the gingiva indicated thin gingival tissue, otherwise it indicated thick tissue. Cephalometric angles UI-SN and IMPA were used to determine maxillary and mandibular incisors inclination.

Results: The age range for this study was 15-30 years, out of which 28 were males and 128 were female. The associations among gender, age (grouped), and Using chi square [$\chi 2$], Angle's categorization with gingival biotype was determined. Utilizing multivariate analysis, the relationship between gingival biotypes was evaluated. Angle's malocclusion had no relation with the gingival biotype in both maxilla ($p=0.305$) and mandible ($p=0.258$). Student t-test was used for continuous data. The logistic regression models were carried out for the study variables. There was a strong association between maxillary incisal inclination (UI-SN) and occurrence of thin gingival biotype ($p=0.005$). No correlation was present between mandibular incisal inclination and gingival biotype ($p=0.872$).

Conclusion: As individuals grow older, they are more likely to exhibit a thin gingival biotype than a thick one.Gingival biotype and mandibular incisor inclination do not correlate, while those with greater incisal inclination (UI-SN) had thin gingival biotype. When comparing gingival biotype to Angle's malocclusion and gender, no correlation was detected.

Keywords: Thick Gingival Biotype, Thin Gingival Biotype, IMPA, UI-SN angle, Angle`s Malocclusion

Introduction

The alveolar bone that surrounds the tooth socket, the cementum, the gingiva, the periodontal ligament, and other hard and soft tissues make up the human periodontium.[1] The term "facio-palatal thickness of the gingiva" refers to gingival biotype. There are two categories of gingival biotypes: thick and thin. Gingival biotypes were classified as "flat/thick" or "scalloped/thin" by Ochsenbien and Ross.[2] Lindhe J. later classified gingiva into two biotypes: thick biotype, if gingiva thickness

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was greater than 2 mm, and thin biotype, if gingiva thickness was less than 1.5 mm.[3]

Gingival thickness is considered as a significant feature in achieving the favorable outcomes of orthodontic treatment. An accurate assessment of gingival biotype must be taken into account prior to any treatment planning for the patients undergoing orthodontic procedure. If no attention was paid during treatment planning applying orthodontic pressures could result in the destruction of the periodontium.[4]

People with thick gingival biotype usually have broad underlying bone architecture and a flat gingival shape due to which their gingiva is more tolerant to any inflammation or trauma. In contrast, people with thin gingival biotype have scalloped gingival contour with thin underlying bony architecture. Consequently, their gingiva is more sensitive to any tissue recession or attachment loss.[5] In thin gingival biotype, the orthodontic movement may be deemed detrimental due to the frequency of force, and direction of tooth movement can lead to defects like dehiscence and fenestration.[1] Therefore, thin biotype requires special consideration during orthodontic treatment, as they need special atraumatic treatments and oral hygiene techniques.[6]

Different individuals have shown different clinical appearance of gingiva. The factors that contribute to different clinical appearance include age, genetics, gender, and tooth morphology.[7] The incisor inclination is considered as an essential factor that needs to be evaluated when orthodontic tooth movement is planned. In case of incisor proclination, risk of the gingival recession will be increased when the gingival biotype thickness is less than 0.5mm.[8]

Previous research evaluating the relationship amidst dental malocclusion and biotype found that the incidence of thin gingival biotype is more prevalent in treated orthodontic patients.[9, 10] In the patient with class III malocclusion, the prevalence of gingival recession is more dominant.[11] No significant correlation was demonstrated amidst dental malocclusion and the predominance of gingival biotype when studied previously. Moreover, in earlier studies no association of upper and lower incisors inclination to that of the gingival biotypes have been the focus of various studies.

Hence, this study's objective was to evaluate the relationship of gingival biotype with various dental malocclusions and maxillo-mandibular incisors inclination. This can be helpful to prevent and decrease the risk of gingival recession, fenestration and dehiscence during orthodontic treatment.

Methodology

This cross-sectional study involved a total number of 156 patients (males=28, females=128) age range 15-30 years, seeking orthodontic treatment at Department Liaquat College of Medicine and Dentistry, Karachi. The sample size determination was done using WHO sample size calculator. Before initiation, every patient received thorough information regarding the trial, and their written consent was acquired. A serial number was given to all patients to protect their confidentiality. Three groups of subjects were established: Class I, II and III in accordance with Angle`s malocclusion directives. The study excluded individuals who had gingivitis or pockets larger than 3 mm, gingival recession, were taking medication or had periodontal surgery, had missing teeth, had anterior tooth restorations, or were undergoing orthodontic therapy. Females who were pregnant or nursing were also not included.

Clinical Protocol:

Gingival tissue biotype evaluation:

- Gingival biotype was measured through the gingival margin by using visibility method with help of calibrated and standardized periodontal probe (UNC-15, Hu-Friedy).[11]

- Probing was performed through mid-facial sulcus of maxillary and mandibular central incisor.
- If the probe could be seen through the gingiva, the gingival tissue was regarded as thin; if not, it was regarded as the clinically thick as depicted in Figure I.

Fig. I: a) Thin gingival biotype b) Thick gingival biotype

Angle's malocclusion evaluation:
The patients were divided into three groups according to their malocclusion:

a. Angle's Class I: A typical molar relationship with little crowding, tooth misalignment, cross-bites, rotations, and other anomalies in alignment.
b. Angle's Class II: The buccal groove of the mandibular first molar is reached by the mesiobuccal cusp point of the first maxillary molar.
c. Angle's Class III: The upper first molar's mesiobuccal cusp tip descends backward to the lower first molar's buccal groove.

The lead investigator repeated all measures twice at 10-minute intervals to record the final gingival thickness measurement at each site.

The upper and lower incisors' inclination:
Lateral cephalogram were traced by using acetate matte tracing paper (0.003 inches thick, 8 × 10 inches) under optical illumination for the evaluation of maxillary and mandibular incisors inclination by using UI-SN and IMPA.
UI-SN: The internal angle that forms between the sella-nasion line and the upper incisors' long axis.

IMPA: As illustrated in figure II, the internal angle created between the mandibular plane and the lower incisors' long axis.

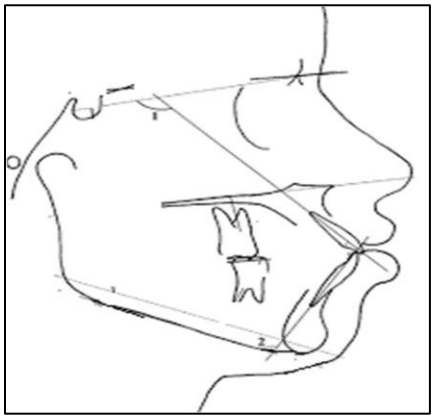

Fig. II:

Statistical Analysis:
SPSS 22.0 was used to tabulate and analyze the data. The mean and standard deviations were calculated for both continuous and categorical data. Using chi square [$\chi 2$], the relationships between gingival biotype and gender, age (grouped), and Angle's categorization were determined. For continuous data, the student t-test was used. To evaluate the relationship between gingival biotypes, multivariate analysis was employed. The study variables were subjected to logistic regression models. P-values less than 0.05 were regarded as significant.

Result

Of the 156 patients in the study sample, 128 were female (mean age: 20.1 ± 3.9) and 28 were male (mean age: 19.1 ± 3.7). There was no significant difference in the mean age distribution between the sexes (p=0.213). Mandibular incisors had significantly higher incidence of thin gingival biotype (65%) than maxillary incisors (40.4%).

Table I:
In table given below the mean incisal inclination of subjects with thin gingival biotype in maxillary incisors was 113.85° ± 9.23°, while in mandible it was 99.16° ± 9.47°.

There seemed to be a significant correlation between maxillary incisal inclination (UI-SN) and occurrence of thin gingival biotype. The occurrence of thin gingival biotype is directly proportional to the inclination of maxillary incisor (p=0.005). Gingival biotype and mandibular incisal inclination do not significantly correlate (p=0.872).

	Thick Biotype	Thin Biotype	t score	p-value
Maxilla (UISN)	109.8° ± 8.3°	113.9° ± 9.2°	-2.828	0.005
Mandible (IMPA)	99.4° ± 8.6°	99.2° ± 9.5°	0.162	0.872

Table I: Means and standard deviation of incisal inclination within gingival biotypes observed with t-score and p values

Table II:

As shown in table II, the occurrence of thin gingival biotype for maxillary arch was 32.1% in males and 42.2% in females. For mandibular arch the occurrence of thin gingival biotype was 53.6% and 68.0% in males and females respectively. There was no significant distinction between the occurrence of thin gingival biotype between the genders in both maxilla (p=0.33) and mandible (p=0.15).

	Maxilla				Mandible			
	Thick	Thin	(x^2)	P value	Thick	Thin	(x^2)	p value
Males 28	19 (67.9%)	9 (32.1%)	0.963	0.326	13 (46.4%)	15 (53.6%)	2.104	0.147
Females 128	74 (57.8%)	54 (42.2%)			41 (32.0%)	87 (68.0%)		
Total 156	93 (59.6%)	63 (40.4%)			54 (34.6%)	102 (65.4%)		

Table II: Counts and percentages of thick and thin gingival biotypes within gender for maxillary and mandibular arch with chi-square (x^2) and p-values

Table III:

In the maxilla, the mean age of participants with thin gingival biotype was 20.4 ± 4.2 years, while that of subjects with thin gingival biotype was 19.2 ± 3.3 years. On average, patients with thick gingival biotype were 20.5 ± 4.2 years old, while those with thin gingival biotype were 19.6 ± 3.7 years old. In the upper incisors (p=0.054) and lower incisors (p=0.855), the age distribution of thick and thin gingival biotypes did not differ significantly. Angle's classification was present in 48.7% of the sample as a whole, 45.5% in Class II, and 5.8% in Class III. There was no statistically significant difference between the genders and Angle's classification (x^2=2.331; p=0.312).

	Class I	Class II	Class III
Male (28)	15 (53.6%)	10 (35.7%)	3 (10.7%)
Female (128)	61 (47.7%)	61 (47.7%)	6 (4.7%)
Total (156)	76 (48.7%)	71 (45.5%)	9 (5.8%)

Table III: Counts and percentages of class I, II and III subjects by gender

Table IV:

There was no significance difference between gingival biotypes and Angle's classification for both maxilla (P=0.305) and mandible (p=0.258).

	Maxilla				Mandible			
	Thick	Thin	(x^2)	p value	Thick	Thin	(x^2)	p value
Class I 76	50 (65.8%)	26 (34.2%)	2.374	0.305	28 (36.8%)	48 (63.2%)	2.711	0.258
Class II 71	39 (54.9%)	32 (45.1%)			25 (35.2%)	46 (64.8%)		
Class III 9	4 (44.4%)	5 (55.6%)			1 (11.1%)	8 (88.9%)		
Total 156	93 (59.6%)	63 (40.4%)			54 (34.6%)	102 (65.4%)		

Table IV: Counts and percentages of gingival biotypes within angles class for both arches, with chi-square (X^2) and p-values

Table V:

The study showed that both age and maxillary incisal inclination (UISN) had a positive correlation with occurrence of thin

gingival biotype using stepwise multivariate binary logistic regression model. Furthermore, it showed that for every one unit increase in age, the odds of having thin gingival biotype is 1.1 times than thick gingival biotype when controlled for other factors such as UISN, gender, angles class and IMPA.

	Odds ratio	95% Confidence Interval		P value
		Lower	Upper	
UISN	1.060	1.018	1.103	0.005
Age (years)	0.908	0.830	0.994	0.036

Table V: Stepwise binary logistic regression with maxillary incisor gingival biotype as dependent variable

Discussion

During orthodontic treatment, it is vital to identify the gingival biotype. Particularly in the maxillary anterior area, gingival morphology is crucial in deciding the ultimate cosmetic result. The thickness of gingiva also plays a crucial role in treatment planning for implants, extractions, prosthodontics and orthodontics.[12] Previous studies have showed that people with thick gingival biotype have reduced risk for gingival recession. Consequently, it played a crucial part in preventing gingival recession in the event that alveolar bone was diminished.[13, 14] Thin gingival biotype are less stable therefore, the chances for gingival recession are more common in these cases.[11] Patient with thin biotype are more prone to epithelial damage hence, they need special treatment procedures. In subjects with thin gingival biotype, force magnitude applied by the orthodontist should be carefully monitored. Bone resorption usually occurs in the direction of tooth if the alveolar bone is thin during orthodontic tooth movement.[15]

Various methods to assess the gingival biotype include invasive and non-invasive methods. Invasive methods include needles, injections, endodontic files, transparency of probe, and histological procedures. Visual inspection, ultrasonic devices, parallel profile radiographs, and CBCT are examples of non-invasive techniques.[16,17] In present study, visibility of periodontal probe method was selected because it is considered to be rapid, non-invasive, a-traumatic and more cost effective. In contrast, visual assessment is not appropriately reliable as shown in previous studies.[18,19] It was discovered that CBCT measurements accurately reflect the thickness of both bone and gingiva[20]. However, cost and radiation exposure make CBCT less desirable and more harmful.

Previous research has indicated a significant correlation between gender and gingival biotype.[7,16-18] Muller et al and Kolte et al explored that males primarily have thicker gingival biotype. These results were consistent with those of De rock-et-al, concluded that 84% of males have thicker gingival biotype when compared with females.[16,17,21] Similarly, Manjuntah et al reported, in their study that males have thick gingival biotype with 76.9% while female was having thin gingival biotype with 44.7%. However, in our study, a non-significant result was obtained between gender dimorphism.[5]

The current study demonstrated a significant positive correlation between age and between gingival thicknesses and reported that that thick gingival biotype is more likely to be found in patient with younger age. These findings are consistent with earlier surveys carried out by Kolte et al and Bhatet et al which showed that the thick gingival biotype is more common in younger age groups than in older age groups.[21, 22] The reason for this may be age related thinning of the epithelium. However, a contradictory result was stated by Matarese et al, found that gingival biotype and age groups did not correlate.[23]

There is limited literature available suggesting the relationship between the

thickness of gingiva and malocclusion. Zawawi et al, Matarese et al and Alkan O et al, reported that a non-significant correlation between Angle's malocclusion and gingival biotype was found which in harmony with the finding of present study.[9,23,24]

Our study also included the incisors' inclination as a significant feature. When planning orthodontic tooth movement, the incisor inclination is considered as a significant factor. A thorough clinical assessment of gingival biotype can assist the orthodontist in making informed decisions because thin gingival biotype is thought to be a contributing cause for gingival recession during orthodontic treatment.

The previous studies conducted by Zawawi et al reported that the thin gingival biotype is strongly related with the proclination of mandibular incisors.[25] Moreover, no association was observed between inclination of maxillary incisors and the gingival biotypes. However, this study concluded that the thin gingival biotype is more prevalent in patient with increased maxillary incisor inclination (UI-SN) but it has no relation with mandibular incisor inclination (IMPA).

Conclusion

1. As an individual's age grows, thin gingival biotypes are more prevalent than thick gingival biotypes.
2. Gingival biotype is thin in those with increased incisal inclination (UISN), but there is no association amidst gingival biotype and lower incisor inclination.
3. Gingival biotype, gender, and Angles malocclusion did not correlate.

Ethical Approval

The study was approved by the Institutional Review Board of Liaquat College of Medicine & Dentistry, Karachi. Ref No.IRB/D-000021/21

Disclaimer

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Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

SKD: Literature Search, Conceptualization of Study Design, Methodology, Data Collection, Data Analysis, Data Interpretation, Resources and Write-Up.

AS: Supervision, Writing-Review and Editing, Validation, Proof Writing and Project Administration.

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