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Original Article

Evaluation of the Association Between Different Face Forms and Gingival Tissue Phenotype

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ABSTRACT

Objective: To evaluate the association between gingival tissue phenotype and different vertical facial patterns.

***Study Design*:** Cross-sectional study.

Place and Duration of Study: Department of Orthodontics, Armed Forces Institute of Dentistry, Combined Military Hospital, Rawalpindi Pakistan, from May 2021 to Nov 2022.

Methodology: Sixty-nine patients with good periodontal health who had not yet begun orthodontic treatment were chosen. The gingival phenotype was evaluated clinically. Patient face type was evaluated on the basis of two angles: maxillomandibular plan angle (MMA) and cranial base to mandibular plan angle (SN-MP) on lateral cephalograms.

Results: The age of subjects ranged from 16 to 34 years (mean age 20.3±4.9) with nearly equal number of males 33(47.8%) and females 36(52.2%) subjects. Gingival type was not found to be correlated with both gender as well as age ($p>0.05$). However, a significant correlation was seen between gingival and vertical facial types ($p=0.01$). A significant difference was also seen between the attached maxillary and mandibular gingival widths and the vertical facial types ($p=0.005$ and $p=0.05$, respectively).

***Conclusion*:** The hyperdivergent face form is associated with a thin gingival phenotype, and the hypodivergent face form is associated with a thick gingival biotype. The normodivergent face type had a higher frequency of thin gingival biotypes in the studied population.

Keywords: Hypodivergent face, Gingiva, Phenotype, Normodivergent face.

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INTRODUCTION

Patients seek orthodontic treatment not only for functional improvement but also for enhancement of esthetics.[1] Esthetic outcome of orthodontic treatment is primarily influenced by the patient's gingival tissue phenotype. Gingival phenotype can be defined as a three-dimensional volume of gingival tissue that includes the labiolingual thickness of the gingiva and the width of attached keratinized mucosa.[2] Orthodontic treatment and the health of periodontal tissue are closely related. According to available evidence, during fixed orthodontic therapy, there is a significant increase in the accumulation of subgingival microorganisms and plaque deposition, resulting in gingival inflammation and bleeding on probing.[3] When there is inflammation, thin gingival biotypes are more likely to have gingival recession, and thick gingival biotypes are more likely to develop periodontal pockets.[4] Similarly, the width of the keratinized gingiva (WKG) is another important factor that needs to be evaluated before the commencement of orthodontic therapy. A minimum of 2mm of WKG is essential for successful orthodontic treatment without periodontal problems.[5] Therefore, it is crucial to precisely determine gingival phenotype during the planning and execution of orthodontic therapy. A systematic review, found a positive association between gingival thickness and attached gingival width.[6]

Based on vertical cephalometric analysis, face form can be divided into hyperdivergent, hypodivergent and normodivergent. Hyperdivergent face form is characterized by increased vertical growth and is associated with increased sella-nasion at the gonion-gnathion and maxillary-mandibular plane angles. Normodivergent is characterized by normal vertical face growth. Hypodivergent face form is characterized by reduced vertical facial growth, decreased sella-nasion to gonion-gnathion angle, and decreased maxilla-mandibular plane angle.[7]

The maxilla and mandible have distinct alveolar bone cortical thicknesses that are influenced by growth patterns, with horizontal facial growth patterns exhibiting increased cortical bone thickness.[8] Similarly, it can be assumed that the vertical growth pattern of the face might affect the phenotypic characteristics of soft tissue such as gingiva. Therefore,

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the objective of this study was to evaluate the relationship between gingival phenotype and different vertical facial types.

METHODOLOGY

The cross-sectional study was performed at Armed Forces Institute of Dentistry, Rawalpindi, Pakistan after approval from the Research Ethical Committee of the (ERC# 918/Trg), from May 2021 to September 2022. The sample size was calculated using OpenEpi software, taking the effect size assumed to be 1.00.[9]

Inclusion Criteria: Patients with permanent upper and lower anterior teeth and good oral hygiene, were included.

Exclusion Criteria*:* Patients undergoing orthodontic treatment, patients with a history of periodontitis or patients showing signs of active periodontitis, patients taking any medications known to have an impact on periodontal soft tissue, systemic conditions like diabetes, hypertension and leukaemia, pregnant or lactating mothers, smokers, oral breathing pattern and lip incompetency, patients who had restorations or prosthesis in their upper and lower anterior teeth involving gingival margins, were excluded.

Around 500 patients presented to the Orthodontics Department of the Armed Forces Institute of Dentistry during our study period. Of these, 75 subjects were consecutively selected. However, six subjects were dropped out as they did not fall under the inclusion criteria, leaving a sample of 69 subjects. Once selected, informed written consent was obtained from all participants after giving them a brief overview of our study. The probe transparency method was used to measure gingival thickness.[10] A standardized WHO probe was used for all measurements. The probe was inserted gently in the gingival sulcus at the centre of the facial surface of maxillary and mandibular anterior teeth. When the probe was not visible through the gingiva, it was categorized as thick gingiva, and when it was visible through transparency, it was categorized as thin gingiva. Gingiva was examined under a dental operating light.[11]

To measure the width of the attached gingiva, the distance from the gingival margin to the mucogingival junction was measured and subtracted from the sulcus depth, which was calculated as the distance between the gingival margin and the sulcus base. A marked WHO periodontal probe and millimetre scale were used for these measurements.

Pretreatment lateral cephalograms were obtained using Sirona Dental System D64625. Rigid head fixation stabilized the patients' heads while keeping the Frankfurt horizontal plane parallel to the ground. Additionally, subjects were told to relax their lips and close their teeth in centric occlusion. All lateral cephalometric films were traced, and angles were drawn and measured using a conventional manual method. Following cephalometric measurements were used to evaluate face type; SN-MP angle (the relation between the mandible and cranial base) and Maxillomandibular plane angle (the relation between maxillary and mandibular skeletal bases).[12] Subjects were divided into three groups, as shown in Figure.

Normodivergent/ Normal Face Type	MMA = 21-29 SN-MP = 28-36
Hypodivergent/ Short Face Type	MMA ≤ 21 SN-MP ≤ 28
Hyperdivergent/ Long Face Type	MMA ≥ 29 SN-MP ≥ 36

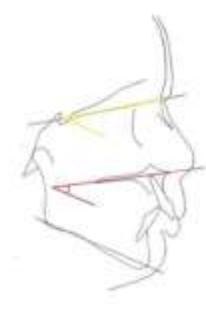

Figure: Cephalometric Tracing showing SN-MP Angle (Upperline) and MMA (Lowerline)

Data was analyzed using Statistical Package for the Social Sciences version 24.0 (SPSS). Categorical variables were measured as frequencies and percentages. Continuous numerical variables were measured as mean and standard deviation. The association between gingival phenotype and face type was evaluated using the chi-square test. In addition, the statistical difference between gingival widths and vertical facial type was evaluated using one-way ANOVA. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 69 subjects were included in this study; their ages ranged from 16 to 34, with a mean age of 20.3± 4.9. Of these, 33 males (47.8%) and 36 females (52.2%) were present. In our study, the sample was classified into three groups on the basis of facial types: Hypodivergent 22(31.9%), Normodivergent 24(34.8%), and Hyperdivergent 23(33.3%).

The gingival type was not found to be correlated with both gender as well as age (p>0.05) (Table-I). However, a significant correlation was seen between gingival and vertical facial types (p=0.01) (Table-II). A significant difference was also seen between the attached maxillary and mandibular gingival widths and the vertical facial types (p=0.005 and p=0.05, respectively) (Table-III).

Table-I: Association of Gingival Thickness with Age and Gender (n=69)

Parameters	Thin Gingival Thickness n=38 (%)	Thick Gingival Thickness n=31 (%)	*p*-value
Age (years)			
<20	19(50.0%)	22(71.0%)	0.13
21-30	16(42.1%)	6(19.4%)	
>31	3(7.9%)	3(9.7%)	
Gender			
Male	17(44.7%)	16 (51.6%)	0.57
Female	21(53.3%)	15 (48.4%)	

Table-II: Association of Gingival Thickness with Vertical Face Type (n=69)

Parameters	Hypodivergent Face Type n=22	Normodivergent Face Type n=24	Hyperdivergent Face Type n=23	*p*-value*
Gingival thickness				
Thick Gingival Thickness	15(68.2%)	10(41.7%)	6(26.1%)	0.01
Thin Gingival Thickness	7(31.8%)	14(58.3%)	17(73.9%)	

chi-square test

Table-III: Comparison of Gingival Width with Vertical Face Type (n=69)

Parameters	Hypodivergent Face Type n=22	Normodivergent Face Type n=24	Hyperdivergent Face Type n=23	*p*-value
Width of Attached Maxillary Gingiva				
Mean±SD	6.6±1.4mm	5.5±1.3mm	5.2±1.6mm	0.005
Width of Attached Mandibular Gingiva				
Mean±SD	5.5±1.3mm	4.7±1.5mm	4.4±1.6mm	0.05

\# *ANOVA test*

DISCUSSION

Periodontal evaluation is of paramount importance before and during comprehensive fixed orthodontic treatment.[11] It can aid in identifying the risk and preventing the occurrence of pathological periodontal problems such as gingival recession and deep periodontal pocketing. It is well known that the thick gingival biotype is more likely to produce periodontal pockets, and the thin gingival biotype is more likely to experience gingival recession. Gingival thickness can be measured using different methods such as visual inspection, transparency of probe, transgingival probing, ultrasonic method, and three-dimensional imaging techniques such as cone beam computed tomography. Visual inspection is not very reliable as it is very much dependent on clinicians' experience and expertise.[12] Transgingival probing is considered the gold standard for evaluating gingival thickness,[13] but it is invasive and requires the administration of local anaesthesia. Although the ultrasonic approach is non-invasive and provides exact readings, it is less practical because of the expensive equipment and limited availability.[14] CBCT gives the most accurate measurements,[15] without any pain to the patient, but it exposes the patient to unnecessary high radiation doses. Transparency of the probe method is a simple, minimally invasive and reliable option that can be easily used in a clinical setting.[16] Considering all the pros and cons of each method, we selected the transparency of the probe method to measure gingival thickness. All measurements were done by one trained clinician.

This study evaluated the correlation between gingival biotype and vertical facial type. We found that there is a statistically significant correlation between the two. Long face form (hyperdivergent) is strongly related to thin gingival biotype and smaller WKG. On the other hand, short face form (hypodivergent) is strongly related to thick gingival biotype and greater WKG. Thin gingival biotype was more prevalent in subjects with normal face type (normodivergent). These findings can be supported by the fact that subjects with hyperdivergent face types generally have smaller maximal bite forces than those with hypodivergent face types.[17] Patients with long faces have weaker masseter muscle and medial pterygoid muscle.[18] The cortical bone thicknesses of the maxilla and the mandible are directly affected by muscle forces, so hypodivergent subjects are more likely to have thicker cortical bone than hyperdivergent subjects due to increased muscle function. Gaffuri *et al.*,[19] found a statistically significant correlation between face types and alveolar bone thickness; subjects with hyper-divergent face forms have thin cortical bone. Various studies have been conducted to determine the correlation between gingival phenotype and thickness of underlying bone, but the results are contradictory.4 However, a recent systemic review by Shafizadeh *et al.*,[20] concluded that a thick gingival phenotype is associated with a thick alveolar bone plate. A study by Salti *et al.*,[21] concluded that gingival recession and clinical attachment loss are more common in individuals with long face forms. This further backs up the findings of our study that hyperdivergent patients are more likely to have a thin gingival phenotype. Contrary to our findings, a study by Kaya *et al.*,[22] found no association between sagittal and vertical craniofacial morphology and gingival phenotype. Valleta *et al.*,[7] found that thin gingiva is less prevalent in subjects with a decreased SNMe/NMe ratio. However, he found no significant relation between gingival thickness and facial types categorized based on the SN-GoGn and CoGoMe angles. Descriptive statistics of our study showed that the thin gingival phenotype was more prevalent in our population. Moreover, individuals with normodivergent face forms tended to exhibit a thin gingival phenotype more significantly. This is consistent with the findings of a similar study on the Middle Eastern population.[9] Age and gender did not show any significant relationship to gingival phenotype. Examining periodontal phenotype before starting comprehensive fixed orthodontic therapy can help plan orthodontic treatment and avoid harmful periodontal sequelae.

CONCLUSION

Hyperdivergent face form is associated with the thin gingival phenotype, while hypodivergent face form is associated with the thick gingival phenotype. The normodivergent face type had a higher prevalence of the thin gingival phenotype in the studied population.

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Authors' Contribution

The following authors have made substantial contributions to the manuscript as under:

NA & EA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AM & QUAT: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

ZN: Data acquisition, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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