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Influence of incisor inclination and position on the gingival biotype of orthodontic patients

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Abstract

Introduction: The inclination and position of incisors are important factors influencing orthodontic planning. Labial or lingual inclination of lower incisors can result in changes of gum levels in the lower labial or lingual attached mucosa. Such gingival recession can be generalized or localized, affecting an area of the tooth or more, and could lead to an aesthetic impairment. Hence the aim of this study was to evaluate the association of gingival biotypes with the position and inclination of the maxillary and mandibular incisor.

Material and Methods: The sample included in this cross- sectional study consisted of 110 orthodontic patients (45 men and 65 women) seeking orthodontic treatment at the Khyber College of Dentistry, Peshawar. Gingival biotype was evaluated with Michigan - O probe. Inclination and position of the upper and lower incisors were evaluated on lateral cephalometric radiographs. The measurements used in the analysis were as follows; For maxillary incisor inclination and position, UI-NA angle and distance were used respectively. For mandibular incisor inclination and position, incisor – mandibular plane angle (IMPA) and mandibular incisor to points N and B (LI-NB) were used respectively. Data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS version 20).

Results: The average age in years of the study sample was 23.56 (± 2.55). No significant difference was found between thin (23.23 ± 2.63) and thick (23.81 ± 2.47) gingival biotypes ($p = 0.18$). Frequency of thin gingival biotype was significantly higher in women than in men in both upper and lower incisors ($p = 0.0001$).

Conclusions: Gingival biotypes (thick and thin) show statistical significance by gender only. Inclination and position of incisors in maxilla were non-significantly associated with the type of gingival biotype.

Keywords: Inclination; gum recession; gingival biotype

Introduction

The inclination and position of the incisors has important implications in treatment planning. These are considered to be important factors when planning orthodontic tooth movement and esthetics of patients. There have been several investigations defining the incisor labial position in the dental arch.[1-4] It has been hypothesized that exaggerated labial or lingual inclinations of incisors can lead to gum recession . Gingival recession can be generalized or localized affecting an area of the tooth or more and could lead to an aesthetic impairment.[5,6] Several factors have been suggested to play a role in the development of gingival recession. The known etiological factors are periodontal disease, brushing trauma and orthodontics expansion of lower arch.[7] The role of orthodontic tooth movement in the development of gingival recession is still debatable.[8-10] Although some have found an increase in gingival recession in adolescents and adults,[3,4,9] others have not found so and proposed it to develop as a result of orthodontic therapy.[1,11] Inconsistencies between these studies could be attributed to the fact that the etiology of gingival recession is complex. Several factors have been suggested to modulate the incidence of gingival recession after orthodontic treatment. Total orthodontic tooth movement, the quality of oral hygiene and gingival

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biotype have been blamed for such a phenomanon.[1-3,12]

The evaluation of the gingival biotype is essential before orthodontic tooth movement since it defines the soft tissue limitations for tooth movement. Gingival biotype can be classified as thin or thick.[13] Biotype is characterized by delicate soft tissue with a minimal amount of the attachment that is sensitive to trauma and inflammation while the thick gingival biotype is characterized by dense, fibrous soft tissues with a large amount of the attachment.[14] Thick gums are suggestive of normal periodontal health. Decreased gingival thickness is considered to be a predisposing factor for recession of the marginal tissues during orthodontic treatment and proper clinical evaluation of gingival biotype ensures accurate decision making during incisors movement. This is supported by evidence where it was observed that an increased risk of gingival recession after orthodontic treatment occurred when thickness of free gingival margin was less than 0.5 mm.[3] The prevalence of thin gingival biotype varies amongst populations[15] and the association between malocclusion and prevalence of gingival recession is still controvercial.[15] Therefore the aim of this study was to determine the association between gingival biotypes with the position and inclination of the maxillary and mandibular incisors.

Material and Methods

The sample of this cross sectional study consisted of 110 orthodontic patients (45 males and 65females) seeking orthodontic treatment at the Khyber College of Dentistry, Peshawar. The consent form was obtained from all the participants prior to their enrollment in the study. Patients with history of previous orthodontic or periodontal surgery, missing maxillary or mandibular anterior teeth, gingival inflammation, extensive restorations, lactating or pregnant women, patients who were taking medicines with known effects on periodontal soft tissues , required antibiotic cover prior to dental examination were excluded from this study.

Gingival biotype was evaluated using Michigan-O probe with colored markings.[16] This assessment method is based on the principle of visibility of the probe through gingival margin while probing the gingival groove. The depth of the probe was restricted to the depth where resistance was felt.[17,18] When the periodontal probe could be seen through the gum, It was classified as thin and vice versa when not seen on probing.

Inclination and sagittal position of the upper and lower incisors were evaluated on lateral cephalometric radiographs using Kodak 9000C panoramic and cephalometric digital radiographic system. The head of each subject was stabilized by positioning the ears rods of Ceph machine in the ears of patients keeping Frankfurt horizontal plane parallel to the floor and sagittal plane at right angles to the path of the X-ray beam with teeth in centric occlusion and lips in relaxed position .The cephalometric radiographs were placed on acetate papers and were manually traced. The following measurements were used.

1. **Maxillary incisor inclination (UI-NA angle)**: The angle formed by the intersection of a line from the Nasion to A point (NA) with a line drawn along the long axis upper central incisor (U1).
2. **Maxillary incisor position (UI-NA distance)**: The distance between the upper central incisor (U1) crown tip to the NA line.
3. **Mandibular incisor inclination (IMPA):** The angle formed by the intersection of a line drawn along the mandibular plane (Gonion - Menton) with a line drawn along the long axis of the mandibular central incisor (L1)
4. **Mandibular incisor position (LI-NB distance).** The distance formed from the lower incisor tip crown tip (L1) to the NB line.

Data were compiled and analyzed using the SPSS (version 20.0). Means and frequency distributions were calculated for continuous

and categorical variables. The relationships between the gingival biotypes, gender, inclination and the position of the maxillary or mandibular incisors were assessed using the chi-square for categorical data and Student's t test for continuous data. The multivariate analysis to assess the relationship between gingival biotypes and study variables were performed using logistic regression models. A p-value less than 0.05 was considered to be statistically significant.

Results

The average age in years of the study sample was 23.56 (± 2.55) with no significant

Table I

Maxillary arch	Thin biotype	Thick biotype	Significance
Males (45)	12	33	P=0.0001
Females(65)	42	23	P=0.0001

Mandibular arch	Thin biotype	Thick biotype	Significance
Male (45)	14	31	P=0.0001
Female (65)	39	26	P=0.0001

Table II: Incisor indication and position and subjects with thin and thick gingival biotypes

Variable	Gingival biotype				P-value
	Thin		Thick		
	Mean	SD	Mean	SD	
Maxillary Arch					
Incisor inclination	24.76	3.21	23.4	3.33	0.88
Incisor position	6.1	2.02	6.00	2.14	0.87
Mandible Arch					
Incisor inclination	96.05	6.21	93.62	5.87	0.021
Incisor position	5.62	2.72	4.60	2.64	0.029

difference between thin (23.23 ± 2.63) and thick (23.81 ± 2.47) gingival biotype (p = 0.18). Gender variation between the maxillary and mandibular gingival biotype was found (Table 1). Frequency of thin gingival biotype was significantly higher in women than in men for both upper and lower incisors (p = 0.0001). The comparison between thin and thick gingival biotypes with regards to inclination and position of the incisors was also performed.

Table III: Multivariable association between the studied variables and gingival biotype in the maxilla

Variable	Odds ratio	95% confidence interval		P-value
		Lower	upper	
Gender				
Age in years				
Maxillary incisor inclination (degrees)	4.11	1.76	9.80	0.001
	1.04	0.87	1.22	0.57
	1.04	0.89	1.04	0.66
Maxillary incisor position (mm)	0.96	0.83	1.16	0.82

Table IV: Multivariable association between the studied variables and gingival biotype in the mandible

Variable	Odds ratio	95% confidence interval		P-value
		Lower	upper	
Gender				
Age in years				
Mandible incisor inclination (degrees)	4.86	2.34	11.06	0.001
	1.02	0.86	1.24	0.74
	1.04	1.00	1.12	0.048
Mandibular incisor position (mm)	1.21	1.04	1.37	0.005

The maxillary incisor proclination and anterior position was not found to be related to the gingival biotype i.e. similar biotype was found in either case. This was not so in the mandibular labial segments where thin gingival biotype was mostly found in labially positioned or proclined teeth. No significant difference in the analysis of space was found between thin and thick gingival biotypes in the mandibular arch. Regression analysis for maxillary incisors (Table 3) showed that

women were 4.2 times more likely to have thin gums than men (p = 0.001). Other variables were not significantly associated with gingival biotypes. In the mandibular arch (Table 4) women were nearly five times more likely than men to have thin gingival biotype.

Discussion

The results of this study showed that mandibular incisor proclination and protrusion were significantly associated with thin gingival biotype, whereas no such association was observed between the gingival biotypes and position/inclination of the maxillary incisors. Reduction of gingival thickness is a factor that may contribute to periodontal tissue breakdown.[5] Therefore, the direction and magnitude of orthodontic forces must be carefully controlled particularly in subjects with thin gingival biotype. During orthodontic tooth movement, several biological events occur leading to bone remodeling in the alveolar process which supports the teeth.[16] Bone resorption occurs in the direction of movement of the tooth leading to a reduction of volume of the alveolar bone. Therefore, the limits of the hard and soft tissues that describe teeth envelope should be carefully analyzed.[17] It has also been suggested that one of the indications for periodontal surgery is to increase the soft tissue thickness of the gums when orthodontic movement is planned to procline the lower labial segment.[19] Similarly when teeth are moved for greater distances, the thickness of the bone and gum covering the roots could be affected.[4,10,12] Hence careful mechanics should be undertaken when attempting labial movement with thin gums.[19] Previously the difference between maxillary and mandibular gingival biotypes have not been identified, however recently the uniqueness of gingival biotype that may vary from maxillary and mandibular arches has been questioned.[20] To date, no previous study has evaluated the association between gingival biotypes, angle and position of the upper and lower incisors before the orthodontic treatment , which was addressed in this study. Knowledge about the prevalence of thin or thick gingival biotypes can be useful in patient and risk assessment for orthodontic patients. Patients with thin gingival biotype can benefit from gingival augmentation before orthodontic treatment. Further studies to test this concept should be undertaken. The limitations of this study were its cross sectional nature and therefore gives no information on the sequence of events. Another limitation was that the sample was drawn from a pool of patients from one center and may affect the conclusions.

Conclusions

Gingival biotypes (thick and thin) show statistically significant variation gender wise only. Inclination and position of maxillary incisors were related to the biotype non-significantly but significantly in the mandibular arch.

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