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The association between gingival biotypes and alignment of maxillary and mandibular anterior teeth: A clinical study

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Abstract
The principle objective of orthodontic treatment is re-designing of smile, an important aspect of smile which is the "infrastructure" has a basic foundation consisting of biological width, bone thickness and the gingival "bio-type" which should be carefully evaluated as it helps in devising an appropriate treatment plan and treatment mechanics in achieving a predictable esthetic outcome.
Aim: The purpose of the present study was to assess the distribution of gingival biotypes in the local population and to determine how the age and gender of the subjects interplay with tooth alignment in the determining the gingival biotype.
Materials and Method: The study group included 1000 periodontally healthy male and female individuals of different age groups. Facial Gingival thickness was assessed in the maxillary and mandibular anteriors by transgingival probing (TGP).
Results: It was observed that there was statistically significant association between alignment of teeth and age with the type of gingival bio-type (P<0.001). The gingiva was found to be thicker in females than males, in the mandibular arch than the maxilla with statistical significance (P<0.001).
Conclusion: In the present study, it was concluded that gingival thickness varies according to age, gender and alignment of the teeth.
Clinical significance: Use of simple and reliable method to assess type of gingival bio-type in clinical practice helps determine whether the orthodontist can advance or tip teeth without producing a bony dehiscence and gingival recession and this could help to tune the treatment for the individual and predict the specific outcome.

Keywords: age, alignment, gender, gingival thickness, transgingival probing

1. Introduction
It has been long known that the clinical appearance of healthy marginal marginal periodontium differs in individuals and even among different tooth types. Many features are directly genetically determined, other's seemed to be influenced by tooth size, shape and position and biological phenomena such as growth and aging [1, 2, 10]. There are two main types of gingival morphology, namely the scalloped and thin or flat and thick gingiva. The term ''periodontal biotype'' was later introduced to categorize the gingiva into ''thick-flat'' and ''thin-scalloped'' biotypes [3]. The thin tissue biotype was defined to have a gingival thickness of less than 1.5 mm, and the thick tissue biotype was referred to as having a tissue thickness greater than 2mm [4]. The thin periodontal biotypes are friable, due to the fragility of tissue, delicate management is essential for avoiding recession. Conversely, a thick biotype is fibrotic and resilient, making it resistant to surgical procedures and orthodontic tooth movement with a tendency for pocket formation (as opposed to recession).The facial-lingual thickness of the attached gingiva and bone is important because it provides stability to the gingival margin and resistance to gingival recession. Different periodontal biotypes, thick-flat versus thin-scalloped, respond differently to inflammation, orthodontic movements, and surgical insult. Thickness of the alveolar bone and gingiva may determine whether the orthodontist can advance or tip teeth without producing a bony dehiscence and gingival recession.
In addition, the ability to change gingival margin location through tooth movement maybe affected by whether the biotype is thick or thin. Many methods were proposed to measure tissue thickness. These include direct measurements, probe transparency (TRAN), ultrasonic devices [9] and most recently, cone-beam computed tomography (CBCT).

Thus the use of a simple, direct and reliable clinical method to discriminate thin from thick gingival based on the transparency of the periodontal probe (TGP) through the gingival margin was used. The gingival biotype was considered thin when the outline of the periodontal probe showed through the gingival margin from inside the sulcus. The biotype was considered thick if the probe did not show through the gingival margin.

2. Materials and Methods

In this clinical study a sample size of 1000 periodontally healthy male and female individuals of different age groups and alignment of the dental arch (well aligned, proclined, retroclined, crowding and spacing) were included to assess the thickness of the facial gingiva of anterior teeth segments by transgingival probing (TGP).The inclusion criteria were (a) individuals with healthy periodontal tissues with no loss of attachment (b) presence of all anterior teeth in both the upper and lower jaws.

The following exclusion criteria were considered (a) subjects with crown restorations or fillings involving the incisal edge of anterior maxillary teeth,(b) pregnant or lactating female volunteers and (c) subjects taking medication affecting the periodontal tissues such as cyclosporin A, calcium channel blockers and phenytoin.

3. Methodology

3.1 Clinical evaluation of gingival biotype: The gingival biotype of the maxillary and mandibular anterior teeth was determined using a William's periodontal probe for each of the subjects. The biotype was assessed by probing the gingival sulcus at the midfacial aspect maxillary and mandibular central incisor, lateral incisor and canine. The gingival biotype was then categorized as either thick or thin according to the visibility of the underlying periodontal probe through the gingival tissue (Figure 1-2). If the outline of the underlying probe could be seen through the gingiva it is categorized as thin biotype and if it is not seen it is categorized as thick biotype and tabulated based on age, gender and dental arch alignment. (Figure 3). Following which it is subjected to statistical analysis.

Fig 1: Clinical sample of subject with thin gingival-biotype

Fig 2: Clinical sample of subject with thick gingival-biotype

Fig 3: Transgingival probing

4. Results

On examination of 1000 periodontally healthy male and female individuals of different age groups and alignment of the dental arch (well aligned, proclined, retroclined, crowding and spacing) to assess the thickness of the facial gingiva of anterior teeth segments by transgingival probing (TGP).

It was found that the percentage distribution of thick gingival bio-type was found to be the highest in well aligned anterior segment, incisors (35%) and canines (65%) and the distribution of thin gingival bio-type was found to be the highest in proclined anterior segment, incisors (71%) and canines (54%) (Tables (1–2), Figure (4-5)). The distribution of the gingival biotype according to the alignment of teeth in relation to the lower incisors and lower canines, showed a the percentage of thick gingival bio-type which was found to be the highest in well aligned anterior segment, incisors (47%) and canines (55%) and distribution of thin gingival bio-type was found to be the highest in proclined anterior segment, incisors (66%) and canines (61%) (Tables (3-4), Figure (6-7)

Based on the distribution of the gingival biotype in well –aligned teeth according to the age percentage increase in thick gingival bio-types in both upper and lower anterior segment was seen in the younger age group (11-30yrs) and the percentage distribution of increased thin gingival bio-types in both upper and lower anterior segment was seen in the older age group (<30yrs) (Table (5)). The distribution of the gingival biotype in well –aligned teeth according to gender showed a percentage increase in thick gingival bio-types was found in the lower incisors in females which Table (6). All of which was statistically significant (P<0.001).

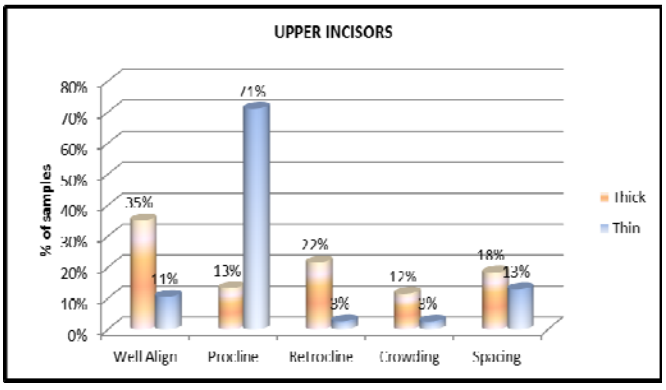

Fig 4: Distribution of the gingival biotype according to the alignment of teeth: upper incisors

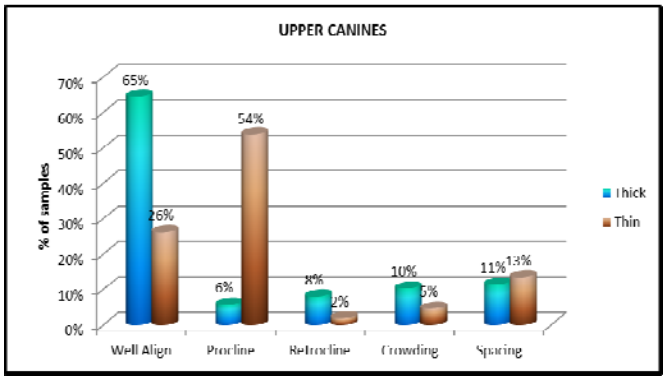

Fig 5: Distribution of the gingival biotype according to the alignment of teeth: upper canines

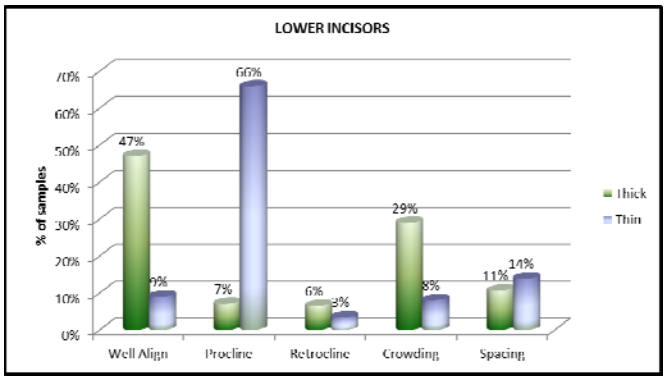

Fig 6: Distribution of the gingival biotype according to the alignment of teeth: lower incisors

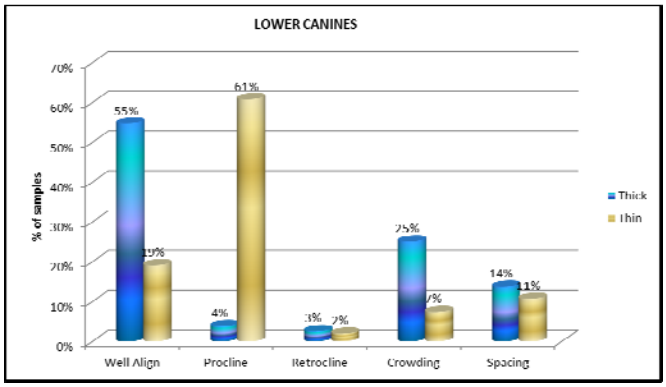

Fig 7: Distribution of the gingival biotype according to the alignment of teeth: lower canines

Table 1: Distribution of the gingival biotype according to the alignment of teeth: upper incisors.

Alignment	Arch - Upper Incisors				
	Biotype				Total
	Thick	%	Thin	%	
Well Align	920	35%	147	11%	1067
Procline	347	13%	991	71%	1338
Retrocline	563	22%	37	3%	600
Crowding	300	12%	36	3%	336
Spacing	478	18%	181	13%	659
Total	2608		1392		4000

Table 2: Distribution of the gingival biotype according to the alignment of teeth: upper canines

Alignment	Arch - Upper Canines				
	Biotype				Total
	Thick	%	Thin	%	
Well Align	942	65%	142	26%	1084
Procline	83	6%	291	54%	374
Retrocline	117	8%	10	2%	127
Crowding	150	10%	25	5%	175
Spacing	167	11%	73	13%	240
Total	1459		541		2000

Table 3: Distribution of the gingival biotype according to the alignment of teeth: lower incisors

Alignment	Arch - Lower Incisors				
	Biotype				Total
	Thick	%	Thin	%	
Well Align	1267	47%	117	9%	1381
Procline	189	7%	860	66%	1049
Retrocline	173	6%	44	3%	217
Crowding	780	29%	104	8%	884
Spacing	285	11%	181	14%	466
Total	2694		1306		4000

Table 4: Distribution of the gingival biotype according to the alignment of teeth: lower canines

Alignment	Arch - Lower Canines				
	Biotype				
	Thick	%	Thin	%	Total
Well Align	814	55%	98	19%	912
Procline	57	4%	312	61%	369
Retrocline	38	3%	10	2%	48
Crowding	373	25%	38	7%	411
Spacing	205	14%	55	11%	260
Total	1487		513		2000

Table 5: Distribution of the gingival biotype in well –aligned teeth according to the age.

Age (Yrs)	Upper Arch					Lower Arch				
	Incisors		Canine			Incisors		Canine		
	Biotype		Biotype			Biotype		Biotype		
	Thick	Thin	Thick	Thin	Total	Thick	Thin	Thick	Thin	Total
5-10	21	7	18	4	50	74	14	27	4	119
11-20	294	26	226	82	628	2	0	332	10	344
21-30	482	71	280	151	984	943	315	325	64	1647
31-40	93	29	89	102	313	438	358	105	15	916
41-50	26	6	13	9	54	48	44	24	2	118
51-60	8	8	2	5	23	19	9	4	2	34
TOTAL	924	147	628	353	2052	1524	740	817	97	3178

Table 6: Distribution of the gingival biotype in well –aligned teeth according to gender

Arch	Male (Total)	Incisors		Canine		Female (Total)	Incisors		Canine	
		Biotype		Biotype			Biotype		Biotype	
		Thick	Thin	Thick	Thin		Thick	Thin	Thick	Thin
Upper	848	345	67	376	60	1308	580	79	574	75
Lower	918	495	58	334	31	1379	770	59	495	55

5. Discussion

In recent years, the assessment of gingival thickness, has become the subject of interest in orthodontics from both a therapeutic and esthetic point of view. The thickness of masticatory mucosa is evaluated by invasive methods using injection needle, probe [5], histologic sections [6], or cephalometric radiographs [7]. The thickness of masticatory mucosa has also been evaluated by non-invasive methods such as ultrasonic devices [8] but proved to be non-reliable when the thickness of gingiva exceeds 2–2.5mm [9]. Although several studies have previously investigated the thickness of palatal mucosa by TGP and only a few reported the thickness of facial gingival using the same method, the present study was undertaken to evaluate the association of gender, age, and dental arch alignment with the gingival bio-type in the local population. Within the limits of the present study, it is demonstrated that on comparision between upper and lower arches in relation to different alignment of teeh, well aligned upper and lower anterior teeth presented with thick gingival bio-type and proclined upper and lower anterior teeth presented with thin bio-type, younger subjects have significantly thicker gingival bio-type in well aligned arches than older subjects and females exhibited a thicker gingival bio-type as compared with males in the mandibular arch. Since gingival thickness is a significant predictor of the clinical outcome of certain tooth movements in orthodontics, other factors that may influence the thickness of the gingival such as genetic and racial factors need to be further investigated.

6. Conclusion

1. The association between alignment and biotype in upper incisors, canines, lower incisors and canines is found to be statistically significant. Well aligned teeth showed thick gingival bio-type and proclined teeth showed thin gingival bio-type in both upper and lower dental arches.
2. There is no association between gender and biotype in upper incisors, upper canines and lower canines. But there is a significant association between gender and biotype in the lower incisors (females have a more thicker biotype).
3. The association between age and biotype in upper incisors, canines, lower incisors and canines is found to be statistically significant. Younger age group (11-30 years) showed thick gingival bio-type and older age group (< 30 years) showed thin gingival bio-type.

   Clinical significance : The Use of simple, direct and reliable method to assess type of gingival bio-types in clinical practice helps determine whether or not the orthodontist can advance or tip teeth without producing a bony dehiscence and gingival recession this could inturn help to tune the treatment for the individual and predict the specific outcome.

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