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ASSESMENT OF GINGIVAL THICKNESS AND THE WIDTH OF KERATINIZED GINGIVA IN THE MANDIBULAR ANTERIOR REGION OF INDIVIDUALS WITH DIFFERENT DENTAL MALOCCLUSION GROUPS AND LEVELS OF CROWDING.

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Abstract

Objective: The objective of this study was to evaluate the width and thickness of keratinized gingiva in mandibular anterior region of individuals with different dental malocclusion groups and levels of crowding.

Methods: The study group included 180 periodontally healthy subjects (102 females and 78males, age groups 16 to 24 years) who presented at the Himachal Institute of Dental Science, Paonta Sahib for orthodontic treatment. The participants involved in the study was divided according to Angle's classification into Class I, Class II, Class III malocclusion. Each group was further subdivided according to level of crowding into mild, moderate, severe. Width of keratinized gingiva was evaluated as the distance between the mucogingival junction and the free gingival margin. The thickness was determined by transgingival probing technique in mandibular anterior segment. Analysis of variation test and Tukey's post- hoc test was done for comparison of various groups in relation to width and thickness of keratinized gingiva.

Results: Width of the keratinized gingiva and gingival thickness were observed as being higher in the severe crowding group and at the mandibular canine teeth in the mild crowding group in mandibular anterior region.

Conclusions: In the present study we conclude that there is no significant relation between gingival thickness and width of keratinized gingiva according to the Angle's classification in mandibular anterior region.

Key words: Crowding, Gingival Width, Thickness.

INTRODUCTION

The oral mucosa consists of three zones, masticatory mucosa namely (the gingiva and hard palate), specialized mucosa (the tongue) and the lining mucosa (oral mucous membrane). Macroscopically, the gingiva is divided into marginal, attached, and interdental areas. Orban[3] first described the term attached gingiva as that part of the gingiva that is firmly attached to the underlying tooth and bone and is stippled on the surface. Ochsenbein and Ross[11]indicated two main types of gingival morphology: 1) scalloped and thin 2) flat and thick gingiva. A more comprehensive term "periodontal biotype" was later introduced by Seibert and Lindheto categorize the gingiva into "thick–flat" and "thin–scalloped" biotypes. Currently, gingival biotype is a term used to define the bucco-lingual thickness of the gingiva. The role of the attached gingiva width (AGW) in maintaining periodontal health has been investigated in adults. It has been observed that in the absence or following the removal of the attached gingiva the remaining tissue (alveolar mucosa) will curl and will not respond to treatment.[4] In addition, alveolar mucosa will not withstand the rigors of mastication or oral physiotherapy.

The contour of alveolar bone and shape and size of dental root plays an important role to determine gingival thickness. It can be classified into two thick and thin biotype.[1] A gingival thickness of ≤ 1 mm is classified as belonging to the thin biotype, while a gingival thickness of >1 mm is classified as belonging to the thick biotype . Becker, proposed three different periodontal biotypes: flat, scalloped and pronounced scalloped gingival.[12]

To prevent pathological periodontal problems, such as gingival recession due to orthodontic treatment gingival thickness should be carefully evaluated. Gingival thickness plays an important role for success of periodontal and orthodontic treatment. A controlled orthodontic force for movement of teeth within the limits of alveolar bone reduces the chances of any pathological problems. It has been noted that tooth movement exceeding the anatomical limits of the alveolar bone, causes dehiscence and fenestrations especially in individuals who display the thin gingival biotype resulting in gingival recession. Yared et al.[11] studied the relationship between gingival recession and the health status of periodontal tissue, amount of tooth movement, the width of keratinized gingiva (WKG), and gingival thickness, and concluded that gingival recession is more frequent when gingival thickness is less than 0.5 mm, and width of keratinized gingiva is less than 2 mm. The researchers also noted that gingival thickness is a factor with greater importance than protrusion movement.

Most of studies have been published that relate to an evaluation of the correlation between gingival thickness and malocclusions.[2,29,22] No study have evaluated the association between keratinized gingival width and malocclusions. Therefore the present study aims to investigate the relationship of gingival thickness and width of keratinized gingiva in different malocclusion groups and levels of crowding.

MATERIALS ANND METHODS

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics at Himachal Institute of Dental Sciences, Poanta Sahib (H.P). The study was conducted on one hundred and eighty patients (102 females and 78 males) aged 16 to 24 years, who had reported to the Department of Orthodontics and Dentofacial Orthopaedics and Department of Periodontics for treatment. Informed consent was obtained from the patients or their parents. Ethical clearance had been taken from college ethics committee. The inclusion criteria included periodontally healthy subjects with complete permanent dentition (with exception of third molars) were included in the

study. The exclusion criteria included, history of previous orthodontic treatment; periodontal surgery; the presence of attachment loss or a pocket deeper than 4 mm; any congenital anomaly; patient undergoing pregnancy or lactation period; any systemic problems and related medications that have impact on thickness of gingival tissue; any syndromic patients.

The participants were divided into three groups on the basis of Angle's classification of malocclusion. Amongst 180 samples, 77 subjects had Angle's Class I malocclusion, 72 subjects had Angle's Class II malocclusion and 31 subjects had Angle's Class III malocclusion. These groups were again subdivided according to level of crowding into: a) mild, b) moderate, c) severe, according to criteria given by Sayin Mo et al.[26] The same has been given in Table A.The mesio-distal width of each tooth, including the canine teeth, was measured from the mandibular plaster models with a digital vernier caliper(Rabbit force digital caliper with sensitivity 0.01 mm) and arch length was measured from canine to canine with the help of brass wire (with error of 0.5mm) by keeping the brass wire at incisal edge from canine to canine. The amount of crowding was calculated by subtracting the mesio–distal width of the tooth obtained with the help of vernier calliper with the arch length measured with brass wire. This study evaluated the severity of crowding by the amount of space required and was divided into three groups; mild (0 - 3 mm),moderate (4 – 6 mm), severe (> 6 mm) according to criteria given by Sayin Mo et al.[26]

TABLE A.

	Mild (a)	Moderate (b)	Severe (c)
Group I (77)	30	27	20
Group II (72)	33	28	11
Group III (31)	14	13	4

To measure gingival thickness measurement points were marked on the gingiva using a marking pen. Then xylocaine spray (Lidyan, lidocaine topical aerosol USP, India) was administered to the patient at the marking point. The measurements was performed 10 minutes after the xylocaine spray was administered by perpendicularly inserting a 20 number endodontic spreader (Mani spreaders, India) with the silicone stopper to the gingiva until the tip of the spreader touch the periosteum of buccal cortical plate. For each patient new spreader was used. Measurement was carried out from points on the buccal aspects of the mandibular anterior teeth (canine – canine): between apical to free gingival margin and coronal to muco-gingival junction. The distance from the tip of the spreader to silicone stopper was measured with the help of a digital caliper (Rabbit force digital caliper) with a sensitivity of 0.01mm. To eliminate the error the distance between tip and silicone stopper was measured three times and arithmetic mean value was noted (Figure1).

To assess the width of attached gingiva the muco-gingival junction was demarcated by the Lugol's iodine solution. It was applied with a cotton pellet using light pressure on the subject's gingiva and alveolar mucosa till a sharp demarcation between keratinized tissue and alveolar mucosa was seen. The width of keratinized gingiva was measured from the muco-gingival junction to the free gingival margin at the buccal area of mandibular anterior teeth with the help of digital verniercaliper (Rabbit force digital caliper) with a sensitivity of 0.01mm. To eliminate the error, the distance between the muco-gingival junction to the free gingival margin was measured three times and arithmetic mean value was noted (Figure 2).

Fig 1: MEASUREMENT OF GINGIVAL THICKNESS

Fig 2: MEASUREMENT OF GINGIVAL WIDTH

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS (Statistical Package for the Social Sciences) version 16, IBM Corp, USA. Normality testing of the data using Shapiro-Wilk test showed that the data were normally distributed. Hence, the comparison of various groups in relation to width and thickness was done using Analysis of Variance (ANOVA). Multiple comparisons were done using Turkey's post-hoc test, chi square test. The level of significance for the present study was fixed at p-value of less than 0.05.

RESULTS

The study sample consisted of one hundred and eighty patients. A one-way ANOVA was conducted to determine if there are any differences in the width and thickness of gingiva in different malocclusions and crowding groups. The data were normally distributed for each group as assessed by Shapiro-Wilk test ($p>0.05$). The data are presented as Mean and Standard Deviations. In the present study, the width of keratinized gingiva were observed being higher in mandibular incisor teeth in (severe crowding group) and in mandibular canine teeth (mild crowding group). Table 1 represents the width of keratinized gingiva in different crowding groups in relation to different lower anterior teeth. Width of keratinized gingiva was higher in severe crowding group in relation to tooth (31= 3.02±0.41mm, 32 = 4±0.65mm, 41= 3.21±0.47mm, 42 = 3.85±0.54mm). It was highest in mandibular lateral incisors as compared to mandibular centrals incisors. In case of mild crowding group, width of keratinized gingiva was higher in relation to tooth (33 = 2.50±0.33mm, 43 = 2.51±0.40mm).

Thickness of keratinized gingiva were observed being higher at mandibular incisor teeth in severe crowding group and at mandibular canine teeth in mild crowding group. Table 2 represents the thickness of keratinized gingiva in different crowding groups in relation to different lower anterior teeth. Thickness of keratinized gingiva was higher in severe crowding group in relation to tooth (31 = 0.72±0.05mm, 32 = 0.84±0.08mm, 41 = 0.71±0.05mm and 42 = 0.87±0.07mm). In severe crowding group, the thickness of keratinized gingiva was highest in 32 and 42 as compared to 31 and 41. In case of mild crowding group thickness of keratinized gingiva was higher in relation to 33

and 43. (33 = 0.71±0.07 mm, 43= 0.68±0.07 mm).The mean gingival width of mandibular anterior region in case of different dental malocclusion were Class I (2.84 ±0.24 mm), Class II (2.80± 0.19mm) and Class III (2.76 ±0.27) given in Table 3. The mean gingival thickness of mandibular anterior region in case of different dental malocclusion were Class I (0.71±0.03mm), Class II (0.70±0.04mm) and Class III (0.67±0.04) given in Table 4. No statistically significant difference was observed between the width of keratinized gingiva and gingival thickness of the lower anterior teeth according to Angle classification.

Table 1: Group wise distribution of mean values of gingival thickness and width of keratinized gingiva in relation to different lower anterior teeth.

	number	subgroup	Tooth Number					
			31	32	33	41	42	43
Mild	77	GW (mm)	2.49±0.31	3.22±0.47	2.50±0.33	2.84±0.36	3.14±0.53	2.51±0.40
		GT (mm)	0.63±0.08	0.69±0.08	0.71±0.07	0.69±0.07	0.71±0.09	0.68±0.07
Moderate	68	GW (mm)	2.28±0.49	3.18±0.65	2.07±0.51	2.65±0.58	3.29±0.70	2.07±0.52
		GT (mm)	0.61±0.10	0.74±0.10	0.66±0.07	0.64±0.10	0.72±0.12	0.64±0.08
Severe	35	GW (mm)	3.02±0.41	4.00±0.65	1.86±0.42	3.21±0.47	3.85±0.54	1.77±0.33
		GT (mm)	0.72±0.05	0.84±0.08	0.58±0.11	0.71±0.05	0.87±0.07	0.59±0.07
Total	180	GW (mm)	2.51±0.48	3.36±0.66	2.21±0.49	2.84±0.51	3.34±0.65	1.77±0.33
		GT (mm)	0.64±0.09	0.74±0.10	0.67±0.09	0.67±0.08	0.75±0.11	0.65±0.08

TABLE 2: Mean values of gingival thicknessand gingival width of keratinized gingiva in Angle's malocclusion groups.

	Class I	Class II	Class III	p-value	Post hoc comparison
GW(mm)	2.84±0.24	2.80±0.19	2.76±0.27	0.097	NS
GT(mm)	0.71±0.03	0.70±0.04	0.67±0.04	0.087	NS

DISCUSSION

In present study, the relationship of the gingival thickness of each mandibular anterior tooth with the severity of crowding was evaluated, primarily because the gingival thickness may be subject to variation depending on the position of the teeth in the dental arch.[30] In addition, space analysis was performed by including the canine teeth, and gingival thickness of keratinized gingiva was higher in severe crowding group in relation to tooth (31 = 0.72 mm, 32 = 0.84 mm, 41 = 0.71 mm and 42 = 0.87 mm) as shown in Table 1. In severe crowding group the thickness of keratinized gingiva was highest in 32 and 42 as compared to 31 and 41 with ($p < 0.001$). In case of mild crowding group thickness of keratinized gingiva was higher in relation to tooth (33 = 0.71 mm, 43= 0.68 mm) with ($p < 0.001$). So from above data it was concluded that with the increase in the level of crowding, it is expected that the gingival thickness of the mandibular canines will decrease. This is primarily owing to the fact that they erupt in a more vestibular position and in addition, the gingival thickness of the mandibular central and lateral incisors increases; this also takes place because they erupt in a more lingual position.[30]Similar result was also obtained by Yesim Kaya et al. (2017) observed that the gingival thickness of the mandibular left central and lateral incisors, and the mandibular right lateral incisor were significantly higher in the severe crowding group ($p < 0.05$). Notably, although the gingival thickness of the mandibular right central incisor was higher in the severe crowding group, the difference was not statistically significant. The gingival thickness of the mandibular canines were higher in terms of statistical significance in the mild crowding group ($p < 0.05$). Very few studies have been published in the extant literature that focus on evaluating the relationship between the gingival biotype and the level of crowding. Of the available studies, Zawawi et al. (2014) observed that there is no significant association between the level of crowding and gingival thickness in the mandibular anterior region. In this study, it was observed that periodontal probing

was used to measure gingival thickness; the space analysis was performed by including only mandibular incisors; and only the mandibular central incisor was taken as a reference to detect the gingival biotype of subjects.

In the present study the width of keratinized gingiva in different crowding groups in relation to different lower anterior teeth was higher in severe crowding group in relation to tooth (31 = 3.02 mm, 32 = 4 mm, 41 = 3.21mm and 42 = 3.85mm) as shown in Table 1, Graph 1. In severe crowding group the width of keratinized gingiva was highest in 32 and 42 as compared to 31 and 41. In case of mild crowding group width of keratinized gingiva was higher in relation to tooth (33 = 2.51 mm, 43= 2.52 mm) $p < 0.05$). The width of keratinized gingiva of the mandibular left central and lateral incisors and mandibular right lateral incisor are significantly higher in the severe crowding group ($p < 0.05$), compared to the other groups. This could be due to as the tooth germs of mandibular permanent incisors are positioned lingually with respect to the mandibular primary incisors. Thus, there is a tendency for the mandibular permanent incisors to erupt somewhat lingually and in an irregular position, even in children who have normal dental arches. Furthermore, this position cannot be corrected in the event of crowding. In addition, the extant literature reports that the tooth germs of mandibular lateral incisors are positioned more lingually compared to the tooth germs of mandibular central incisors and, in cases where crowding is an issue, this facilitates eruption in a more lingual position than mandibular central incisors. Moreover, the width of keratinized gingiva of lingually erupting teeth are reported as being higher according to study conducted by Wennstrom et al. (1996).[30] When the level of crowding increases, it is expected that the width of keratinized gingiva of the mandibular canines will decrease. This is primarily owing to the fact that they erupt in a more vestibular position and, in addition, the width of keratinized gingiva of the mandibular central and lateral incisors increases; this also takes place because they erupt in a more lingual position. In the extant literature relating to the width of keratinized gingiva, very few studies have been published regarding the relation between the width of keratinized gingiva of each mandibular anterior tooth and the level of crowding. Similar result was also obtained by Yesim Kaya et al. (2017)[21] observed that the gingival width of the mandibular left central and lateral incisors, and the mandibular right lateral incisor were significantly higher in the severe crowding. Notably, although the gingival thickness of the mandibular right central incisor was higher in the severe crowding group, the difference was not statistically significant. The gingival thickness of the mandibular canines werehigher in terms of statistical significance in the mild crowding group ($p < 0.05$).

The present study displayed no statistically significant relationship between the width of keratinized gingiva and gingival thickness with the Angle classification in the mandibular anterior region. The mean gingival width of mandibular anterior region in case of different dental malocclusion were Class I (2.84 ±0.24 mm), Class II (2.80± 0.19mm) and Class III (2.76 ±0.27) as shown in Table 2 . The mean gingival thickness of mandibular anterior region in case of different dental malocclusion were Class I (0.71±0.03mm), Class II (0.70±0.04mm) and Class III (0.67±0.04) as shown in Table 2. A limited number of studies exist in the literature that have evaluated the association of gingival biotype with different dental malocclusion groups. Among these, Zawawiet al. (2012)[2] studied 200 individuals and reported that no statistically significant relationship was observed between the gingival biotype and Angle's classification. Their study used periodontal probing to determine the gingival biotype and only the maxillary central incisor was used as a reference to determine the gingival biotype of subjects. Matarese et al (2016)[11] , in a study focusing on 76 individuals, assessed biotype by employing periodontal probing at the mid-facial aspect of the maxillary central, lateral incisors, and canines, and found that no statistically significant relationship existed between the gingival biotype and Angle classification. The researchers also noted that the gingival thickness is subject to change on the basis of tooth position, facial characteristics, and profile, thereby warranting further study to evaluate the impact of these parameters. Consistent with these results, our study showed that there is no statistically significant relationship between the mean gingival thickness of the mandibular anterior region and Angle's classification. Yesim et al. (2017)[21] in a study consisting of 187 periodontally healthy subjects (121 females and 66 males) evaluated the

gingival biotype and width of keratinized gingiva in mandibular anterior region of individuals with different dental malocclusion groups and level of crowding and observed that within the limits of this study, the results demonstrate that, there is no significant relationship of width of keratinized gingiva and the mean gingival thickness in the mandibular anterior region according to the Angle's classification.

CONCLUSION

Within the confines of this study, the following conclusion can be drawn:

1. When the level of crowding increases, there is corresponding significant increases in width of keratinized gingiva and gingival thickness.
2. The comparison of width of keratinized gingiva in relation to severity of crowding revealed that width of keratinized gingiva were observed to be higher at mandibular incisor teeth in severe crowding groups and at mandibular canine teeth in mild crowding groups.
3. The comparison of gingival thickness in relation to severity of crowding revealed that thickness of keratinized gingiva were observed to be higher at mandibular incisor teeth in severe crowding groups and at mandibular canine teeth in mild crowding groups.
4. The comparison of width in relation to Angle's classification revealed that there was no significant difference in mean gingival width between Class I, Class II, Class III malocclusion.
5. The comparison of thickness in relation to Angle's classification revealed that there was no significant difference in mean gingival thickness between Class I, Class II, Class III malocclusion.

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