MEANDROS MEDICAL AND DENTAL JOURNAL
2024 September (3):279-291

Meandros Medical and Dental Journal
doi: 10.69601/meandrosmdj.1548929

Research Article

THE ASSOCIATIONS OF ADHERENT GINGIVAL THICKNESS IN THE BUCCAL AND PALATAL REGIONS OF THE MAXILLA AND MANDIBULA WITH AGE AND GENDER

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ABSTRACT

Objective: This study aimed to investigate gingival thickness variations regarding age, gender, and sites where mini-screws are frequently applied and to guide mini-screw size selection.

Materials and Methods: In our study, gingival thickness measurements were performed by a transgingival probing method in 224 patients who presented for examination to the Department of Orthodontics, Faculty of Dentistry, Aydın Adnan Menderes University. Fifty-six females and 56 males aged 14-20 and 21-27 years were enrolled in the study. In each individual, measurements were made from the mucogingival junction at the interdental area in the buccal mandibular and buccal maxillary regions, whereas at the interdental area within 4 mm and 8 mm distance from the gingival crest in the palatinal maxilla.

Results: Comparisons between genders indicated that gingival thickness in the buccal region of the maxilla was statistically significantly greater in males than in females ($p<0.005$). In age-based comparisons, gingival thickness in the buccal and palatinal regions of the maxilla in younger age group individuals was significantly less than in older age group individuals ($p<0.005$). Interregional comparisons revealed that gingival thickness was most significant in the molar zone in the buccal region of the mandible, in the incisor zone in the buccal region of the maxilla, in the premolar zone within 4 mm of the maxillary palatinal region, and the molar zone within 8 mm of the maxillary palatinal region.

Conclusion: Our study results suggest that the gingival thickness varies with age and gender in different mini-screw applied sites.

Keywords: Gingival thickness, maxilla, mandibula

Received: 12 September 2024
Revised: 27 September
Accepted: 30 September 2024
Published: 30 September 2024

MEANDROS MEDICAL AND DENTAL JOURNAL
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Meandros Medical and Dental Journal
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INTRODUCTION

The gingiva is the masticatory mucosa lining the alveolar ridge and surrounding the cervical aspect of the teeth (1). Periodontal probe visualization, transgingival measurements, ultrasonic devices, direct visual inspection, transformer probing, and cone beam computed tomography can determine gingival thickness (2). In orthodontics, anchorage refers to resistance against undesired tooth movements. Anchorage planning and control are of critical importance in orthodontic management. Anchorage loss during orthodontic treatment is among the most significant complications that can be encountered. Therefore, anchorage control should be considered from initiating orthodontic treatment (3).

Mini-screws, which are among the anchorage devices, have been favored frequently in recent years for their advantages, such as providing total anchorage capacity, easy applicability, not requiring patient cooperation, their small size, their possibility to be used for anchorage purposes without waiting for osteointegration like dental implants, and their easy removal when their function is over(4-6). The sites in the mouth where mini-screws are frequently applied are the mucogingival junction in the interdental buccal area and the interdental sites 4mm and 8mm from the gingival crest in the palatinal region (7).

On the other hand, drawbacks restricting mini-screw use include complications such as inflammation of soft tissues, damage to adjacent structures, and the lack of initial stability (8-9). Many factors, including mini-screw-related, patient-related, surgical application-related, and anatomical structures-related factors, affect successful mini-screw use. The mini-screw-related factors include the mini-screw's length and shape, the mini-screw's diameter and groove structure, the material that the mini-screw is made of, and the mini-screw's surface properties. As the length, diameter, number of grooves, and distance between the grooves increase, the mini-screw's stability increases (10). Age, gender, oral hygiene, and systemic diseases are among the patient-related factors affecting the success of the mini-screw. The mini-screw loss rate is higher in patients with poor oral hygiene than those with adequate oral hygiene.

The dimensions of the mini-screws to be positioned vary based on the application sites. The bone content and gingival thickness in the application site of the mini-screw are critical factors in mini-screw selection. In cases in whom the bone content is insufficient or the gingival thickness is excessive, the mini-screw application's failure rate is higher (9). This study aimed to investigate gingival thickness variations by age, gender, and mini-screws' common application sites and also to guide the mini-screw size selection process. Our study's working hypothesis was 'There are no significant differences in the thickness of adherent gingiva among different sites, age, and gender groups concerning the mini-screw application. On the other hand, our study's alternative hypothesis was 'There are significant differences for mini-screw application among different sites, age, and gender groups regarding adherent gingival thicknesses.

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MATERIALS AND METHODS

Study Sample

The present study was conducted as an analytical cross-sectional prospective study. A total of 56 male and female individuals aged 14-20 years and 56 male and female individuals aged 21-27 years, who voluntarily agreed to participate in the study and presented to Aydin Adnan Menderes University, Faculty of Dentistry, Department of Orthodontics for examination were enrolled in our study.

The sample size required to detect the difference between male and female patients was calculated using the G*Power 3.1.9.2 software and was based on the upper jaw p2m1 point measurements in the study "Soft Tissue Thickness for Placement of an Orthodontic Miniscrew Using an Ultrasonic Device" by Cha et al. (11) The effect size was determined as 0.538. For this effect size, taking the Type-1 error as 0.05, the Type-2 error as 0.20, and the female-to-male ratio as 1, it was determined that a minimum of 56 individuals were needed for each group.

The participants were informed verbally and in writing, and informed consent forms were obtained. Participants over 18 signed the informed consent form, whereas those under 18 and their parents/guardians signed it. The inclusion criteria were as follows: being between 14-27 years of age, having no systemic disease, being free of any medication that might affect periodontal tissues, having no previous orthodontic or prosthodontic treatment, not being pregnant or lactating, maintaining good oral hygiene, and not having any missing teeth except for the third molars.

On the other hand, the exclusion criteria were defined as the age not being within the 14-27 years range, presence of a systemic disease, taking any medication that would interfere with periodontal tissues, previous orthodontic or prosthodontic treatment, being pregnant or breastfeeding, lack of good oral hygiene, and missing any teeth other than the third molars. Participants who fulfilled the study criteria and agreed to participate were divided into two groups based on age distribution. The numbers of females and males were distributed equally in each group. Group 1 comprised 56 females and 56 males aged 14-20 years, and Group 2 comprised 56 females and 56 males aged 21-27.

Ethical approval was obtained from the Clinical Research Ethics Committee in Faculty of Dentistry , University of Aydin Adnan Menderes on February 24, 2021 (DHF2021/06). Taking the regions shown in the study by Papadopoulos and Tarawneh as a reference, measurements were made in the maxillary buccal, mandibular buccal, and maxillary palatinal regions, respectively (7). Table 1 show the buccal and palatinal measurement sites. All measurements were performed by the same observer (C.G.). Regarding the measurement process, first, the measurement sites were topically anesthetized with Vemcaine spray containing 10% lidocaine (Vem İlaç, Istanbul).

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Table 1. Measurement sites in the buccal regions of the maxilla, mandibula and in the palatinal regions of the maxilla

Maxilla	
B-11-21	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right central and left central tooth
B-11-12	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right central and right lateral tooth
B-12-13	adherent gingiva adjacent to the mucogingival junction in the right lateral and interradicular area of the right canine tooth
B-13-14	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right canine and right 1st premolar
B-14-15	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 1st and right 2nd premolars
B-15-16	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 2nd premolar and 1st molar
B-16-17	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 1st molar and right 2nd molar
B-21-22	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left central and left lateral tooth
B-22-23	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left lateral and left canine teeth
B-23-24	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left canine and left 1st premolar
B-24-25	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 1st and 2nd premolars
B-25-26	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 2nd premolar and left 1st molar
B-26-27	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 1st and 2nd molars
Mandibula	
B-31-41	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right central and left central tooth
B-31-32	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left central and left lateral tooth
B-32-33	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left lateral and left canine teeth
B-33-34	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left canine and left 1st premolar
B-34-35	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 1st and 2nd premolars
B-35-36	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 2nd premolar and left 1st molar
B-36-37	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the left 1st molar and left 2nd molar
B-41-42	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right central and right lateral teeth
B-42-43	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right lateral and right canine teeth
B-43-44	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right canine and right 1st premolar
B-44-45	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 1st and 2nd premolars
B-45-46	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 2nd premolar and 1st molar
B-46-47	adherent gingiva adjacent to the mucogingival junction in the interradicular area of the right 1st molar and right 2nd molar
4 mm from the gingival crest in the palatinal regions of the maxilla	
P4-11-21	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the right central and left central tooth
P4-11-12	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the right central and right lateral tooth
P4-12-13	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the right lateral and right canine tooth
P4-13-14	mucosa 4 mm from the gingival crest in the interradicular area of the right canine and right 1st premolar
P4-14-15	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the right 1st and right 2nd premolars
P4-15-16	mucosa 4 mm from the gingival crest in the interradicular area of the right 2nd premolar and right 1st molar
P4-16-17	mucosa 4 mm from the gingival crest in the interradicular area of the right 1st molar and right 2nd molar
P4-21-22	mucosa 4 mm from the gingival crest in the interradicular area of the left central and left lateral tooth
P4-22-23	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the left lateral and left canine tooth
P4-23-24	mucosa 4 mm from the gingival crest in the interradicular area of the left canine and left 1st premolar
P4-24-25	mucosa at a distance of 4 mm from the gingival crest in the interradicular area of the left 1st and left 2nd premolar teeth
P4-25-26	mucosa 4 mm from the gingival crest in the interradicular area of the left 2nd premolar and left 1st molar
P4-26-27	mucosa 4 mm from the gingival crest in the interradicular area of the left 1st molar and left 2nd molar
8 mm from the gingival crest in the palatinal regions of the maxilla	
P8-11-21	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the right central and left central tooth
P8-11-12	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the right central and right lateral tooth
P8-12-13	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the right lateral and right canine tooth
P8-13-14	mucosa 8 mm from the gingival crest in the interradicular area of the right canine and right 1st premolar
P8-14-15	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the right 1st and right 2nd premolars
P8-15-16	mucosa 8 mm from the gingival crest in the interradicular area of the right 2nd premolar and right 1st molar
P8-16-17	mucosa 8 mm from the gingival crest in the interradicular area of the right 1st molar and right 2nd molar
P8-21-22	mucosa 8 mm from the gingival crest in the interradicular area of the left central and left lateral tooth
P8-22-23	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the left lateral and left canine tooth
P8-23-24	mucosa 8 mm from the gingival crest in the interradicular area of the left canine and left 1st premolar
P8-24-25	mucosa at a distance of 8 mm from the gingival crest in the interradicular area of the left 1st and left 2nd premolar teeth
P8-25-26	mucosa 8 mm from the gingival crest in the interradicular area of the left 2nd premolar and left 1st molar
P8-26-27	mucosa 8 mm from the gingival crest in the interradicular area of the left 1st molar and left 2nd molar

After anesthesia, the endodontic spreader # 15 (Güvenç Dental, Istanbul) was placed at the determined points perpendicular to the gingiva and passively advanced until the bone was contacted. After the silicone

MEANDROS MEDICAL AND DENTAL JOURNAL
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Meandros Medical and Dental Journal
doi: 10.69601/meandrosmdj.1548929

rondel on the spreader was contacted with the gingiva with the help of a dental tweezer, the endodontic spreader was carefully removed from the gingiva to prevent the silicone rondel's movement. After calibrating before the measurements and setting in mm., the digital caliper (Mitutoyo Cihaz, İzmir) was used to measure the distance from the end of the spreader to the silicone rondel. The measurements were recorded in the file created using Microsoft Excel software and based on the patient's gender and age.

Statistical Analysis

It was found that the p2m1 distance had to be re-measured in at least 18.4 images to test the hypotheses H0: ϱ=0.70 and H1: ϱ=0.90 at the type 1 error level of 0.05 and type 2 error level of 0.20 to assess intra-observer agreement (12). Therefore, the pre-treatment measurements of 19 randomly selected patients were evaluated a second time 10 days after the first evaluation. Shapiro-Wilk's test examined the conformity of all adherent gingival thickness measurements to a normal distribution, and these measurements were summarized as mean±ss and median (interquartile range-IQR: first quartile-third quartile). The level of intraobserver agreement for the adherent gingival thickness measurements was evaluated with the intraclass correlation coefficient (ICC). ICC was obtained from a two-way mixed model for absolute agreement and single measurement—a ICC value of 0.90 as excellent agreement (13). Differences in gingival thicknesses according to gender and age group were analyzed by independent two-sample t-test or Mann-Whitney U test. The measurements of the buccal and palatinal surfaces of the canine, premolar, and molar regions in the lower and upper jaw were obtained by averaging the gingival thicknesses of the relevant regions and surfaces and compared by repeated measures ANOVA. Huynh-Feldt correction was applied since the buccal surface gingival thickness measurements of canine, premolar, and molar regions in the mandible did not meet the sphericity assumption. LSD was used as a post-hoc test for multiple comparisons of the regions' gingival thicknesses. The statistical significance level of $p \leqslant 0.05$ was considered. IBM SPSS Statistics 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) software package was used.

RESULTS

Comparison Results by Gender

The ICC values for adherent gingival thickness measurements ranged between 0.940 and 0.999. The intraobserver compliance levels for these measurements were excellent at all measurement sites ($p<0.001$). It was observed that the gingival thickness at points B-45-46, B-46-47, and B-36-37 was statistically significantly greater in males as compared to females ($p<0.05$), whereas no statistically significant inter-gender difference was observed regarding gingival thickness at other points ($p>0.05$). The distribution of the measurements

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Meandros Medical and Dental Journal
doi: 10.69601/meandrosmdj.1548929

made at a distance of 4 mm from the gingiva in the palatinal region of the maxilla by gender is presented in Table 2. Based on these results, no statistically significant difference was found between the two genders regarding the gingival thicknesses in the palatinal region of the maxilla (p>0.05).

Table 2. Comparison of gingival thicknesses at a distance of 4 mm and 8 mm from the gingival margin in the palatinal region of the maxilla by gender

Distance of 4 mm from the gingival margin				
	Males (n=112)	**Females (n=112)**	**Comparison Results**	
Measurement Site	Mean±SD Median (IQR)	Mean±SD Median (IQR)	t/Z	p-value
P4-11-21	2.42±0.20	2.44±0.22	0.700	0.485
	2.43 (2.31-2.55)	2.43 (2.29-2.62)		
P4-11-12	2.66±0.20	2.64±0.24	0.467	0.641
	2.64 (2.53-2.79)	2.65 (2.46-2.83)		
P4-12-13	2.79±0.20	2.75±0.18	1.617	0.107
	2.79 (2.67-2.92)	2.74 (2.64-2.86)		
P4-13-14	3.22±0.25	3.23±0.21	0.229	0.819
	3.23 (3.03-3.39)	3.21 (3.08-3.39)		
P4-14-15	3.28±0.22	3.24±0.23	1.115	0.266
	3.28 (3.10-3.42)	3.27 (3.08-3.39)		
P4-15-16	2.83±0.16	2.84±0.2	0.367	0.714
	2.84 (2.72-2.93)	2.85 (2.72-2.98)		
P4-16-17	2.57±0.24	2.55±0.26	Z=0.600	0.548
	2.61 (2.42-2.72)	2.58 (2.35-2.72)		
P4-21-22	2.66±0.20	2.64±0.24	0.606	0.545
	2.66 (2.54-2.79)	2.65 (2.47-2.81)		
P4-22-23	2.79±0.21	2.75±0.19	1.433	0.153
	2.78 (2.65-2.94)	2.75 (2.64-2.85)		
P4-23-24	3.22±0.25	3.22±0.21	0.129	0.897
	3.24 (3.05-3.37)	3.21 (3.08-3.39)		
P4-24-25	3.28±0.21	3.24±0.23	1.142	0.255
	3.26 (3.10-3.45)	3.27 (3.09-3.4)		
P4-25-26	2.82±0.17	2.84±0.2	Z=0.845	0.398
	2.85 (2.71-2.93)	2.85 (2.70-3.00)		
P4-26-27	2.56±0.24	2.55±0.26	Z=0.467	0.640
	2.60 (2.40-2.75)	2.59 (2.35-2.73)		
Distance of 8 mm from the gingival margin				
	Males (n=112)	**Females (n=112)**	**Comparison Result**	
Measurement Site	**Mean±SD Median (IQR)**	**Mean±SD Median (IQR)**	**t/Z**	**p-value**
P8-11-21	2.29±0.17	2.16±0.18	Z=5.674	**<0.001***
	2.32 (2.18-2.40)	2.16 (2.02-2.31)		
P8-11-12	2.69±0.18	2.64±0.23	2.005	**0.046***
	2.69 (2.55-2.85)	2.65 (2.45-2.80)		
P8-12-13	2.80±0.20	2.77±0.20	Z=0.950	0.342
	2.85 (2.65-2.95)	2.75 (2.65-2.94)		
P8-13-14	3.42±0.18	3.46±0.22	Z=1.631	0.103
	3.45 (3.30-3.51)	3.45 (3.31-3.65)		
P8-14-15	3.52±0.19	3.52±0.22	0.144	0.885
	3.52 (3.42-3.69)	3.54 (3.37-3.65)		
P8-15-16	3.46±0.16	3.47±0.18	Z=0.639	0.523
	3.45 (3.35-3.60)	3.45 (3.35-3.59)		
P8-16-17	3.89±0.19	3.85±0.17	1.358	0.176
	3.85 (3.75-4.03)	3.85 (3.75-3.95)		
P8-21-22	2.70±0.18	2.64±0.24	1.987	**0.048***
	2.70 (2.56-2.85)	2.65 (2.47-2.81)		
P8-22-23	2.81±0.21	2.77±0.20	1.283	0.201
	2.82 (2.65-2.95)	2.78 (2.68-2.91)		
P8-23-24	3.44±0.20	3.47±0.22	0.845	0.399
	3.44 (3.31-3.60)	3.48 (3.30-3.64)		
P8-24-25	3.54±0.20	3.53±0.21	0.529	0.598
	3.54 (3.42-3.71)	3.53 (3.38-3.68)		
P8-25-26	3.46±0.17	3.48±0.18	0.674	0.501
	3.45 (3.35-3.6)	3.46 (3.37-3.59)		
P8-26-27	3.89±0.20	3.87±0.18	0.960	0.338
	3.89 (3.75-4.03)	3.88 (3.74-3.98)		

SD: Standard Deviation, IQR: Interquartile Range. Inter-gender significance levels according to Mann Whitney U test or independent two-sample t-test results; *p<0.05 significance level

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The distribution of the measurements taken 8 mm from the gingiva in the maxillary palatinal region by gender is listed in Table 2. Gingival thicknesses at points P8-11-21, P8-11-12, and P8-21-22 were statistically significantly higher in males than females ($p<0.05$); however, at other points, no statistically significant male-female difference was observed regarding gingival thickness ($p>0.05$). Except for measurement site B-25-26, the gingival thickness was statistically significantly higher in males than females in all other measurements ($p<0.001$ for all measurements).

Comparison Results by Age

Table 3. Comparison of gingival thicknesses at a distance of 4 mm and 8 mm from the gingival margin in the maxillary palatinal region by age groups

Distance of 4 mm from the gingival margin				
	Younger Age Group (n=112)	**Older Age Group (n=112)**	**Comparison result**	
Measurement Site	Mean±SD Median (IQR)	Mean±SD Median (IQR)	t/Z	p-value
P4-11-21	2.33±0.19	2.53±0.19	8.054	<0.001
	2.33 (2.18-2.46)	2.54 (2.38-2.65)		
P4-11-12	2.57±0.20	2.73±0.21	6.075	<0.001
	2.57 (2.45-2.67)	2.74 (2.58-2.89)		
P4-12-13	2.75±0.20	2.79±0.18	1.463	0.145
	2.74 (2.62-2.90)	2.80 (2.67-2.91)		
P4-13-14	3.10±0.20	3.34±0.20	9.195	<0.001
	3.12 (2.97-3.23)	3.34 (3.20-3.49)		
P4-14-15	3.15±0.19	3.37±0.19	8.490	<0.001
	3.13 (3.04-3.30)	3.39 (3.25-3.52)		
P4-15-16	2.77±0.16	2.90±0.17	5.885	<0.001
	2.77 (2.66-2.89)	2.89 (2.77-3.01)		
P4-16-17	2.43±0.22	2.69±0.20	Z=8.352	<0.001
	2.44 (2.28-2.58)	2.70 (2.59-2.81)		
P4-21-22	2.57±0.20	2.73±0.21	5.965	<0.001
	2.58 (2.43-2.69)	2.75 (2.58-2.89)		
P4-22-23	2.75±0.21	2.79±0.19	1.419	0.157
	2.74 (2.64-2.91)	2.80 (2.65-2.92)		
P4-23-24	3.11±0.20	3.34±0.20	8.747	<0.001
	3.11 (2.97-3.24)	3.33 (3.20-3.47)		
P4-24-25	3.15±0.19	3.37±0.19	8.523	<0.001
	3.15 (3.04-3.30)	3.39 (3.25-3.50)		
P4-25-26	2.77±0.17	2.89±0.18	Z=5.209	<0.001
	2.76 (2.66-2.9)	2.90 (2.80-3.02)		
P4-26-27	2.43±0.23	2.68±0.21	Z=8.039	<0.001
	2.45 (2.29-2.58)	2.70 (2.60-2.80)		
Distance of 8 mm from the gingival margin				
	Younger Age Group (n=112)	**Older Age Group (n=112)**	**Comparison result**	
Measurement Site	Mean±SD Median (IQR)	Mean±SD Median (IQR)	t/Z	p-value
P8-11-21	1.17±0.15	1.22±0.18	t=2.373	0.019*
	1.16 (1.06-1.28)	1.23 (1.10-1.38)		
P8-11-12	1.59±0.18	1.63±0.21	1.520	0.129
	1.61 (1.47-1.73)	1.65 (1.49-1.80)		
P8-12-13	1.29±0.16	1.35±0.17	2.599	0.009*
	1.28 (1.18-1.39)	1.33 (1.22-1.51)		
P8-13-14	1.10±0.13	1.23±0.15	t=6.849	<0.001*
	1.11 (1.02-1.19)	1.24 (1.13-1.33)		
P8-14-15	1.14±0.16	1.25±0.16	5.297	<0.001*
	1.16 (1.02-1.25)	1.30 (1.13-1.37)		
P8-15-16	1.03±0.14	1.20±0.17	7.146	<0.001*
	1.04 (0.92-1.13)	1.23 (1.09-1.33)		
P8-16-17	1.04±0.16	1.07±0.15	1.960	0.050
	1.05 (0.95-1.15)	1.11 (0.99-1.18)		
P8-21-22	1.58±0.18	1.62±0.20	1.487	0.137
	1.60 (1.45-1.71)	1.64 (1.49-1.8)		
P8-22-23	1.28±0.16	1.35±0.17	2.667	0.008*
	1.25 (1.15-1.37)	1.34 (1.24-1.5)		
P8-23-24	1.10±0.13	1.23±0.15	6.725	<0.001*

	1.13 (1.03-1.18)	1.25 (1.13-1.34)		
P8-24-25	1.14±0.17	1.26±0.15	5.599	<0.001*
	1.15 (1.03-1.25)	1.29 (1.16-1.37)		
P8-25-26	1.06±0.13	1.07±0.13	0.802	0.423
	1.05 (0.95-1.15)	1.10 (0.99-1.15)		
P8-26-27	1.03±0.14	1.09±0.14	3.360	0.001*
	1.05 (0.95-1.14)	1.12 (0.99-1.17)		

SD: Standard Deviation, IQR: Interquartile Range

Accordingly, at sites B-44-45, B-34-35, and B-31-32, the gingival thickness was statistically significantly higher in the individuals of the older age group compared to those of the younger age group ($p<0.05$); yet, there were no significant differences between the older and younger age groups ($p>0.05$) in the measurements taken at other sites. The distributions of the measurements obtained from the sites 4 mm from the gingiva in the maxillary palatinal regions by age groups are presented in Table 3. Except for the sites P4-12-13 and P4-22-23, the gingival thickness measurements of the older age group were significantly higher than those of the younger age group ($p<0.001$). The distributions of the measurements made at a distance of 8 mm from the gingival margin in the maxillary palatinal region by age group are presented in Table 3.

Table 4. Comparison of gingival thickness in the maxillary buccal region by the age groups.

	Younger Age Group (n=112)	**Older Age Group (n=112)**	**Comparison result**	
Measurement Site	**Mean±SD Median (IQR)**	**Mean±SD Median (IQR)**	**t/Z**	**p-value**
B-11-21	1.17±0.15	1.22±0.18	t=2.373	**0.019***
	1.16 (1.06-1.28)	1.23 (1.10-1.38)		
B-11-12	1.59±0.18	1.63±0.21	1.520	0.129
	1.61 (1.47-1.73)	1.65 (1.49-1.80)		
B-12-13	1.29±0.16	1.35±0.17	2.599	**0.009***
	1.28 (1.18-1.39)	1.33 (1.22-1.51)		
B-13-14	1.10±0.13	1.23±0.15	t=6.849	**<0.001***
	1.11 (1.02-1.19)	1.24 (1.13-1.33)		
B-14-15	1.14±0.16	1.25±0.16	5.297	**<0.001***
	1.16 (1.02-1.25)	1.30 (1.13-1.37)		
B-15-16	1.03±0.14	1.20±0.17	7.146	**<0.001***
	1.04 (0.92-1.13)	1.23 (1.09-1.33)		
B-16-17	1.04±0.16	1.07±0.15	1.960	0.050
	1.05 (0.95-1.15)	1.11 (0.99-1.18)		
B-21-22	1.58±0.18	1.62±0.20	1.487	0.137
	1.60 (1.45-1.71)	1.64 (1.49-1.8)		
B-22-23	1.28±0.16	1.35±0.17	2.667	**0.008***
	1.25 (1.15-1.37)	1.34 (1.24-1.5)		
B-23-24	1.10±0.13	1.23±0.15	6.725	**<0.001***
	1.13 (1.03-1.18)	1.25 (1.13-1.34)		
B-24-25	1.14±0.17	1.26±0.15	5.599	**<0.001***
	1.15 (1.03-1.25)	1.29 (1.16-1.37)		
B-25-26	1.06±0.13	1.07±0.13	0.802	0.423
	1.05 (0.95-1.15)	1.10 (0.99-1.15)		
B-26-27	1.03±0.14	1.09±0.14	3.360	**0.001***
	1.05 (0.95-1.14)	1.12 (0.99-1.17)		

SD: Standard Deviation, IQR: Interquartile Range

MEANDROS MEDICAL AND DENTAL JOURNAL
2024 September (3):279-291

Meandros Medical and Dental Journal
doi: 10.69601/meandrosmdj.1548929

Except for the P8-11-12, P8-16-17, P8-21-22, and P8-25-26 sites, the older age group's gingival thickness measurements were statistically significantly higher than those of the younger age group ($p<0.05$). The distributions of gingival thicknesses obtained from the maxillary buccal regions by age group are shown in Table 4. Except for B-11-12, B-16-17, B-21-22, and B-25-26 sites, the gingival thicknesses were statistically significantly higher in the older age group than in the younger age group ($p<0.05$).

Comparison Results by Regions

The distribution of gingival thicknesses in the incisor, premolar, and molar regions by the measurement sites is presented in Table 5. The mean gingival thicknesses of all three regions were statistically significantly different from each other ($p<0.001$). The mean gingival thicknesses obtained from the mandibular buccal surfaces were 1.14±0.07 mm in the canine region, whereas 1.10±0.11 mm in the premolar region and 1.20±0.09 mm in the molar region. Thus, the maximum gingival thickness was recorded in the molar region and the minimum in the premolar region.

Table 5. Distributions of gingival thicknesses by regions located in buccal (mandibular and maxillary) and palatinal (4 mm and 8 mm) surfaces

	Canine	**Premolar**	**Molar**	**Comparison result**	
Surface	**Mean±SD Median (IQR)**	**Mean±SD Median (IQR)**	**Mean±SD Median (IQR)**	**F**	**p-value**
Mandibular buccal	1.14±0.07	1.10±0.11	1.20±0.09	77.295	**<0.001**[*,1]
	1.14 (1.10-1.19)	1.10 (1.03-1.19)	1.21 (1.15-1.26)		
Palatinal 4mm	2.65±0.13	3.24±0.18	2.69±0.17	1291.847	**<0.001**[*]
	2.65 (2.57-2.74)	3.24 (3.11-3.38)	2.7 (2.58-2.82)		
Palatinal 8mm	2.63±0.13	3.49±0.16	3.67±0.14	4864.306	**<0.001**[*]
	2.63 (2.53-2.73)	3.50 (3.36-3.63)	3.69 (3.55-3.78)		
Maxillary buccal	1.41±0.14	1.18±0.13	1.07±0.13	600.937	**<0.001**[*]
	1.40 (1.30-1.53)	1.17 (1.10-1.28)	1.08 (0.97-1.16)		

SD: Standard Deviation, IQR: Interquartile Range , *P≤0.001 was obtained in all regional pairwise comparisons. The result with Huynh-Feldt correction is given.

DISCUSSION

This study evaluated the variations of the adherent gingival thickness in the buccal and palatinal regions of the maxilla and mandible regarding different age and gender groups. Regarding gender difference, the study found that gingival thickness in the maxillary buccal region was thicker in males than in females. However, In the measurements made in the mandibular buccal region and the maxillary palatinal region at distances of 4 mm and 8 mm from the gingival crest, there were no overall differences in gingival thickness between the genders. Regarding the effect of age, the study found that gingival thicknesses in the maxillary palatinal and buccal regions were more significant in the older age group than in younger age group individuals. However, there was no difference between the older and younger age groups regarding gingival thickness in the mandibular buccal region. Regarding the regional effects, the highest gingival thickness for the molars was in the mandibular buccal region, whereas for the incisors, in the maxillary buccal region. For

palatinal gingival thicknesses, the thickest gingiva located 4 mm from the gingival crest belonged to the premolars region, and the thickest gingiva located 8 mm from the gingival crest belonged to the molars.

Inter-gender Comparisons

Our study revealed no inter-gender difference regarding anterior gingival thickness in the mandibular buccal region. Many studies have evaluated gender-related changes in gingival biotypes in the literature(11,14-16). Alkan et al. evaluated gingival thickness variations in the anterior mandibular region by gender and age in 171 individuals (108 females and 63 males) and reported that the gingival thickness was 0.70±0.15 mm in females and 0.77±0.19 mm in males (14). Vandana and Savitha reported the gingival thickness in the anterior mandibular region in 16 females and 16 males as 1.02±0.33 mm in females and 1.11±0.35 mm in males (15). These studies used the transgingival probing method and reported no inter-gender difference. Our study was consistent with these studies regarding the method and the result.

Contrary to our study, in the study by Zawawi et al., the anterior mandibular gingival thickness was evaluated by periodontal probing in 142 individuals (64 males and 78 females) (16). Their study reported thinner gingiva in females than in males. The reason for the difference between the results of their study and ours might be the different gingival thickness measurement techniques in the two studies. Cha et al. evaluated the gingival thickness variations in the maxilla and mandible in 61 individuals (28 males and 33 females) with an ultrasonic device (11). They found that the gingival thickness changes in the posterior mandibular buccal region concerning gender were not significant. Our study found no statistically significant difference between genders at all sites except for three points. It has been reported that gingival thickness measurement with ultrasonic devices is reliable in the anterior regions but not in the posterior locations because of the difficulty of placing the device (17). It is thought that the difference between the two studies might have been due to differences between the measurement techniques and racial distributions.

Age Group-Based Comparisons

Vandana and Savitha evaluated gingival thickness in the anterior mandibular buccal region in 16 males and 16 females aged 16-38 years and reported that gingival thickness was more significant in the younger age group than in the older age group (15). The reason for the difference between this study and ours might have been racial, genetic, and age-group differences. Alkan et al. evaluated age-related alterations of gingival thickness in the anterior mandibular region in individuals under and over 18; the difference between the two age groups was insignificant, consistent with our study (14).

Alhajj et al. evaluated gingival thickness variations in the posterior maxillary buccal region in 456 individuals (18). Their study's age groups were determined as under and over 25 years. They found that the difference between age groups regarding gingival thickness was not statistically significant. As the reason for

the difference from our findings, we think that Alhajj had a vast age range in his study. While our study's spreader measurements were made with a digital caliper, Alhajj et al. used a periodontal probe. The literature has reported that the measurement sensitivity of the periodontal probe was low (17). Another reason for the difference between their and our results might be the difference in measurement methods.

Inter-Regional Comparisons

Cha et al. compared gingival thickness among regions with the ultrasonic measurement method, and consistent with our study, they found that gingival thickness in the mandibular buccal region was highest in the molar region and lowest in the premolar region, while gingival thickness in the maxillary buccal region was highest in the incisor region and lowest in the molar region (11). Similar to the results of our study, they reported that the maximum gingival thickness was in the posterior palatinal region in the measurements made 8 mm from the gingival crest. However, contrary to our study, the mean gingival thickness in the palatinal region at a distance of 4 mm from the gingival crest was the highest in the anterior region. We think that the difference of their findings from the present study might occur because the gingival thickness in the rugae region might have been affected by individual factors such as genetic factors and oral hygiene.

In another study by Parmar et al., the gingival thickness was compared among regions using the ultrasonic measurement method in 32 individuals (9). It was determined that the gingival thickness in the mandibular buccal region was the highest in the molar region and the lowest in the premolar region, whereas the incisors had the thickest gingivae in the maxillary buccal region. Those results were compatible with our study's results.

CONCLUSION

In conclusion, our study's initial hypothesis was rejected and alternative hypothesis was approved. This study will contribute to the literature due to the high number of patients evaluated, including the comparison of age and gender, the use of a measurement technique that the clinician can practically apply before mini-screw application with a simple endodontic instrument in clinical settings. It may help in the stability of the mini screws to be applied in the maxillary buccal region to choose more extended sizes in male patients than in female patients. However, gender is not a determining factor in selecting the mini-screw size to be applied in the mandibular buccal region and the maxillary palatinal regions at distances of 4 mm and 8 mm from the gingival crest. Regarding the size of the mini-screw to be applied in the maxillary palatinal region, we recommend longer mini-screw sizes in older age groups compared to younger age group individuals. Since gingival thickness might be affected by numerous factors, particularly racial and genetic ones, more research is needed to enrich the literature and enable using guidelines in clinical practice.

Acknowledgments

We thank our patients and their families for their kind cooperation.

Authorship contributions

CG: Surgical and medical practices,concept, design, data collection, analysis or interpretation, literature search, writing. MGC: concept, design , analysis or interpretation, writing.

Data availibity statement

Data can be requested from the authors.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Ethics

The decision of Aydin Adnan Menderse University Faculty of Dentistry Clinical Research Ethics Committee 2021/06, dated February 24, 2021, was obtained.

Funding

This work has not received any funding.

REFERENCES

1. Bartold PM, Walsh LJ, Narayanan AS. Molecular and cell biology of the gingiva. Periodontol 2000. Oct 2000;24:28-55.
2. Zweers J, Thomas RZ, Slot DE, Weisgold AS, Van der Weijden FG. Characteristics of periodontal biotype, its dimensions, associations and prevalence: a systematic review. J Clin Periodontol. Oct 2014;41(10):958-971.
3. Ülgen M. Ortodontik tedavi prensipleri. Ankara: Ankara Üniversitesi Basımevi; 1983.
4. Kuroda S, Sugawara Y, Deguchi T, Kyung HM, Takano-Yamamoto T. Clinical use of miniscrew implants as orthodontic anchorage: success rates and postoperative discomfort. Am J Orthod Dentofacial Orthop. Jan 2007;131(1):9-15.
5. Melsen B. Mini-implants: Where are we? J Clin Orthod. Sep 2005;39(9):539-547; quiz 531-532.
6. Park HS, Kwon TG. Sliding mechanics with microscrew implant anchorage. Angle Orthod. Oct 2004;74(5):703-710.
7. Papadopoulos MA, Tarawneh F. The use of miniscrew implants for temporary skeletal anchorage in orthodontics: a comprehensive review. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. May 2007;103(5):e6-15.
8. Papageorgiou SN, Zogakis IP, Papadopoulos MA. Failure rates and associated risk factors of orthodontic miniscrew implants: a meta-analysis. Am J Orthod Dentofacial Orthop. Nov 2012;142(5):577-595 e577.
9. Parmar R, Reddy V, Reddy SK, Reddy D. Determination of soft tissue thickness at orthodontic miniscrew placement sites using ultrasonography for customizing screw selection. Am J Orthod Dentofacial Orthop. Oct 2016;150(4):651-658.
10. Wilmes B, Drescher D. Impact of insertion depth and predrilling diameter on primary stability of orthodontic mini-implants. Angle Orthod. Jul 2009;79(4):609-614.
11. Cha BK, Lee YH, Lee NK, Choi DS, Baek SH. Soft tissue thickness for placement of an orthodontic miniscrew using an ultrasonic device. Angle Orthod. May 2008;78(3):403-408.
12. Walter SD, Eliasziw M, Donner A. Sample size and optimal designs for reliability studies. Stat Med. Jan 15 1998;17(1):101-110.
13. Portney LG, Watkins MP. Foundations of clinical research: applications to practice Upper Saddle River, N. J.: Pearson/Prentice Hall; 2015.

14. Alkan EA, Alkan Ö, Kaya Y, Keskin S. Alt ve Üst Çene Ön Bölge Diş Eti Kalınlığının Cinsiyet ve Yaşla Olan İlişkisinin Değerlendirilmesi. Türkiye Klinikleri Diş Hekimliği Bilimleri Dergisi. 2016;22(3):157-162.
15. Vandana KL, Savitha B. Thickness of gingiva in association with age, gender and dental arch location. J Clin Periodontol. Jul 2005;32(7):828-830.
16. Zawawi KH, Al-Zahrani MS. Gingival biotype in relation to incisors' inclination and position. Saudi Med J. Nov 2014;35(11):1378-1383.
17. Wang J, Cha S, Zhao Q, Bai D. Methods to assess tooth gingival thickness and diagnose gingival phenotypes: A systematic review. J Esthet Restor Dent. Jun 2022;34(4):620-632.
18. Alhajj WA. Gingival phenotypes and their relation to age, gender and other risk factors. BMC Oral Health. Mar 25 2020;20(1):87.