Original Article

Thickness of Palatal Mucosa and Related Parameters

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Abstract

Background and Aim: The palatal mucosa is a common donor site for gingival grafting. The thickness of mucosa in the hard palate and tuberosity is different in different populations. The aim of this study was to assess the thickness of palatal and tuberosity mucosa and related parameters in patients referred to Isfahan dental centers.

Materials and Methods: This cross-sectional study was performed on 52 patients referred to Isfahan dental centers who were selected by simple random sampling. The thickness of two sites behind the second molar in the tuberosity mucosa and six sites in two lines in the palatal mucosa was measured near the canine, second premolar and second molar teeth with a 27-gauge short cannula. The data were analyzed by t-test, paired t-test, ANOVA, and Pearson's correlation coefficient. $P<0.05$ was considered significant.

Results: In this study, 21 male and 31 female patients were included. The mean age of male and female patients was not significantly different ($P=0.25$). The majority of patients had a thin biotype and the biotype became thicker with age. The thickest area in the palate was at the site of second premolar tooth, but the tuberosity mucosa was the thickest among all the measured sites.

Conclusion: The thickness of tuberosity mucosa was greater than the palatal mucosa, but it has a smaller volume for tissue grafting. In the palatal mucosa, the canine-premolar area has optimal thickness for harvesting and has a safe distance from important anatomical sites.

Key Words: Mucous Membrane; Connective Tissue; Gingiva

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Introduction

Gingival recession causes esthetic and periodontal problems in patients. Therefore, tissue grafting is necessary in patients with gingival recession (1). Gingival recession can be treated by tissue grafting from the palate, tuberosity, and edentulous mucosa donor sites (2). The oral masticatory mucosa consists of two parts, the buccal gingiva and the hard palate mucosa (3). The term biotype is used for the buccal gingival mucosa, and defines the buccolingual gingival thickness. The gingival tissue is classified to thin and thick biotypes based on clinical features. The clinical feature of gingival tissue depends on multiple factors such as genetics, age, gender, tooth shape and

maxillary arch (3,4).
The volume of tissue obtained from the donor site is important and affects the outcome of the procedure (2). The thickness of the graft tissue is also important in wound healing and flap control in surgical procedures. Transplant hematopoiesis may be stopped with very thick or thin graft tissue (5). Therefore, evaluation of the availability and dimensions of the graft tissue is necessary before surgery. Poor outcome and donor site discomfort may be observed in cases with inadequate tissue thickness (6). The tuberosity mucosa is a good donor site for graft harvesting in patients with mucogingival
disease. However, in case of presence of second and third molars, adequate tissue would not be available for harvesting from this region (7).
Different methods can be used for evaluation of oral mucosal thickness. Non-invasive methods such as computerized tomography (CT) and ultrasound and invasive methods such as tissue resection for histological examination have been used in many studies (5-8). Bone sounding is another method for this purpose that provides accurate results regarding the thickness of the masticatory mucosa. There are few studies that examined the palatal and tuberosity mucosal thickness by bone sounding, reporting variable results in different populations (7-10). The aim of this study was to evaluate the thickness of the palatal and tuberosity mucosa and its relationship with different parameters in patients referred to Isfahan dental centers.

Materials and Methods

This study was approved by the ethics committee of Isfahan University of Medical Sciences, Iran (IR.MUI.RESEARCH.REC.1399.474).
This cross-sectional study evaluated the thickness of different areas of the palatal and tuberosity mucosa and related parameters. A total of 52 patients (31 females and 21 males) referred to Isfahan dental centers were selected by convenience sampling. The age range of patients was 20-60 years. They had received greater palatine nerve block for crown lengthening of posterior maxillary teeth. The patients with all teeth from canine to maxillary molars and normal periodontium were included in the study. Patients with a history of surgery, lesion in the palate or tuberosity, palatal orthodontic appliances, or maxillary removable prosthesis were excluded. Furthermore, smoker patients and those with deep palate, systemic diseases or taking medications that affect the periodontium were excluded from the study.
After obtaining informed consent, local anesthesia was administered in the palatal mucosa. The mucosal thickness was measured 30 minutes after injection to prevent the confounding effect of swelling of the mucosal thickness on the results. To calculate the thickness of the palatal mucosa, two hypothetical lines were considered parallel to the marginal gingiva, starting from the middle of the palatal surface of the canine tooth and continuing to the palatal root of the second molar (Figure 1). The distance between the two lines from the gingival margin was 3 and 8 mm as measured with a Williams probe (Joya, Pakistan). Three sites were identified on each line, namely the midline in the middle of the palatal surface of the canine, the middle of the palatal surface of the second premolar, and the palatal root of the second molar.

Figure 1. Location of the measurement sites in the palatal mucosa

For the tuberosity, a line was hypothetically drawn along the central groove of the second molar towards the posterior region, and two

sites were measured at a distance of 2 and 5 mm from the distal surface of the second molar. The mucosal thickness was measured by bone sounding with a 27-gauge short head cannula with a silicone stopper (Figure 2). Then, the thickness of each area was recorded with a probe.

Figure 2. A 27-gauge short head cannula

Furthermore, the gingival biotype of the lower central incisor was determined by the transparency method. The Williams probe was entered into the sulcus from the midfacial part of the tooth surface. If the shadow of the probe was visible through the gingiva, a thin gingival biotype was considered, and if it was not visible, a thick gingival biotype was considered. The data were entered into SPSS version 23 and analyzed using t-test, paired t-test, ANOVA, and Pearson's correlation coefficient. P values < 0.05 were considered significant.

Results

In the present study, 31 female patients with a mean age of 40.45±10.96 years and 21 male patients with a mean age of 38.28±10.86 years were included. Table 1 compares the mean mucosal thickness in the palate and tuberosity. According to paired sample t-test, there was a significant difference between the mean thickness at 3 and 8 mm distances in the canine, second premolar (P<0.001) and second molar (P=0.012) regions. But, there was no significant difference between the mean thickness at 2 and 5 mm distances in the tuberosity area (P=0.948). One-way ANOVA showed that there was a significant difference in the mean thickness at 3 mm distance among the three regions of the palate and 2 mm distance in the tuberosity region (P <0.001). There was a significant difference in the mean thickness at 8 mm distance among the three sites of the palate and 5 mm distance in the tuberosity region (P <0.001).

The Tukey's test was performed for pairwise comparisons. Table 2 compares the mucosal thickness at the four regions of the palate and tuberosity at lines 1 and 2. In line 1, there was no significant difference in the mucosal thickness at the canine, second premolar and second molar sites. Although, thickness of tuberosity mucosa in line 1 was significantly different from the other three regions (P<0.001). But, in line 2, there was only a significant difference between the thickness of the tuberosity mucosa and the second molar mucosa (P<0.001). Also, in this line, a significant difference was observed between the mucosal thickness at the site of second premolar and second molar (P=0.007).

Table 3 shows that according to t-test, there was no significant relationship between the mean thickness at the measured areas of the four palatal regions and tuberosity with gingival biotype or gender (P>0.05). The Pearson's correlation coefficient showed that there was only a significant relationship between mucosal thickness and age at a distance of 8 mm from the second premolar gingival margin (P=0.041, r=0.285), such that the mucosal thickness in this area increased with age. Also, there was a direct and significant relationship between the thickness in line 1 and line 2 at each region. There was also a direct and significant relationship between the tissue thickness of the canine area and other sites (P<0.05).

According to Table 4, the Chi-square test showed that there was a significant correlation between biotype and gender (P=0.014). The ratio of thin to thick biotype was higher in females than males. Furthermore, there was a significant relationship between age and type of

Table 1. Mean and standard deviation of mucosal thickness in different areas of the palate and tuberosity mucosa

Site	Distance (mm)	Thickness (mean± SD)	Minimum	Maximum	P-value
Canine	3	2.82±0.77	1	4.8	< 0.001
	8	3.86±0.97	1.5	6.2	
Second premolar	3	2.99±1.11	1.5	8	< 0.001
	8	4.29±1.37	1.8	8	
Second molar	3	2.85±1.15	1	6.5	0.012
	8	3.41±1.46	0.8	7	
Tuberosity	2	4.55±1.53	2	8	0.948
	5	4.57±1.66	2	8.5	

Table 2. Comparison of mucosal thickness in different areas of the palate and tuberosity

Site	P-value	
	Line 1	Line 2
Canine-second premolar	0.887	0.398
Canine-second molar	0.999	0.339
Canine-tuberosity	< 0.001	0.055
Second premolar-second molar	0.935	0.007
Second premolar-tuberosity	< 0.001	0.743
Second molar-tuberosity	< 0.001	< 0.001

Table 3. Comparison of mucosal thickness in different areas of the palate and tuberosity based on gingival biotype and gender

Site	Distance (mm)	Thickness based on gingival bio-type (mean± SD)			Thickness based on gender (mean± SD)		
		Thin	Thick	P-value	Female	Male	P-value
Canine	3	2.81±0.76	2.84±0.82	0.98	2.79±0.86	2.87±0.63	0.23
	8	3.95±0.84	3.65±1.24	0.35	3.68±0.92	4.13±0.99	0.49
Second premolar	3	3.02±1.25	2.91±0.68	0.44	3.1±1.35	2.81±0.6	0.15
	8	4.49±1.38	3.79±1.25	0.73	4.22±1.38	4.39±1.37	0.94
Second molar	3	2.85±1.17	2.86±1.16	0.78	3±1.17	2.63±1.12	0.79
	8	3.41±1.55	3.39±1.24	0.23	3.34±1.42	3.5±1.54	0.79
Tuberosity	2	4.74±1.49	4.22±1.64	0.52	4.45±1.56	4.8±1.5	0.42
	5	4.6±1.69	4.5±1.66	0.63	4.79±1.8	4.29±1.47	0.25

SD: Standard deviation

Table 4. Frequency distribution of gingival biotype based on gender and age of patients

Gingival biotype	Gender n(%)		Age	Total
	Female	Male	mean± SD	
Thin	26 (83.9%)	11 (52.5%)	37.3±10.08	37 (71.2%)
Thick	5 (16.1%)	10 (47.6%)	45.1±11.07	15 (28.8%)
Total	31 (100%)	21 (100%)	41.2±10.5	52 (100%)

SD: Standard deviation

gingival biotype based on t-test (P=0.017). The biotype became thicker with age.

Discussion

This study assessed the palatal and tuberosity mucosa in 52 patients referred to Isfahan dental centers. Thickness of the palatal mucosa can be measured with different methods such as using needles and probes (2,9,10), histological examination (6,11), computed tomography (12), and ultrasonic devices (8,13). Bone sounding is a common method to measure the palatal thickness. Terakura (14) used an A-mode ultrasound to measure the thickness of the hard palate mucosa at 10 sites and compared the results with a bone sounding method. The mean values obtained by these two methods had a high correlation, which shows that the results obtained with bone sounding are reliable. In a study by Renvert et al, (16) a difference of 0.3 mm between trans-gingival probing and surgery to determine the mucosal thickness was reported. Ursell (17) reported that the difference between bone sounding and surgery was only 0.12 mm. Therefore, in this study, bone sounding method was used to evaluate and compare the thickness of palatal and tuberosity mucosa. However, due to the increase in thickness after local anesthesia injection, measuring the thickness of the palate with this method may have errors. In the present study, precautions were taken to prevent wrong results by using minimal amount of anesthetic agent, slow injection, waiting for at least 30 minutes after injection, and block injection into the greater palatine foramen (10).

In the present study, the maximum mean mucosal thickness was noted at a distance of 5 mm (4.57 mm) and 2 mm (4.55 mm) from the distal of second molar in the tuberosity, and then at a distance of 8 mm from the gingival margin of the second premolar (4.29 mm). The lowest thickness was recorded at to the distance of 3 mm from the gingival margin of the canine tooth (2.82 mm). Similar to our study, Muller et al. (8) reported that after the thickness of retromolar tissue, the thickness of the palatal mucosa at the site of first and second premolars was the highest. In a study by Choudhary et al, (18) the mean thickness at the canine, first premolar, second premolar, first molar, and second molar regions was 1.8, 2.4, 2.9, 3.3 and 3.8 mm, respectively. In a study by Barriviera et al, (19) the mean mucosal thickness at the canine, first premolar, second premolar, first molar, and second molar areas was 2.92, 3.11, 3.28, 2.89, 2.89 and 3.15 mm, respectively.

In a study by Said et al, (20) the greatest mucosal thickness was at a distance of 8-13 mm from the margin of the second molar, canine and premolars, which differed from the results of our study. In this study, the thickness of the palatal mucosa significantly increased from the gingival margin towards the midline of the palate. However, no significant difference in thickness was found in the tuberosity region by moving towards the distal. The reason for this was partly due to submucosa with looser tissue and increased glandular and adipose tissues at the midline of the palate. While, the submucosal tissue has dense connective tissue in the area

near the gingival margin (21).

In the present study, the highest thickness among the evaluated sites in the palate was noted at 8 mm distance at the second premolar region, which has a good distance from important anatomical areas. In most previous studies, canine-premolar areas were the best sites for graft harvesting (8,20). In this study, the highest mucosal thickness was noted at the two measured areas in the tuberosity region (4.57 and 4.55 mm), which is similar to the results of Studer et al (10).

The connective tissue of the tuberosity mucosa consists of dense collagen fibers covered by a keratinized epithelial layer. While, the submucosa of the palate has more adipose tissue than the tuberosity mucosa (15,19). However, harvesting tissue from the tuberosity mucosa may be limited due to difficult access in some cases (10). In 4 out of 52 patients in the present study, the thickness of keratinized tissue of the tuberosity at the distal of second molar was less than 5 mm. In this study, the mean thickness of the palatal mucosa was higher in males than females but not significantly, which was similar to other studies (8,10,22).

In our study, the relationship between the thickness of the palatal mucosa at a distance of 8 mm from the second premolar with age was significant. In other studies, the thickness of the palatal mucosa was lower in younger than older patients (22,23).

In the present study, 71.2% of the patients had a thin biotype and 28.8% had a thick biotype. In a study by Singh et al, (23) the prevalence of thin biotype was higher than thick, which was different from the results of Olssen and Lindhe (24). The reason for these differences can be due to differences in the study population and gingival biotype classification.

In this study, a significant relationship was not found between the palatal and tuberosity mucosal thickness and gingival biotype. Thus, tissue grafts can be harvested from the palate and tuberosity mucosa in patients with thin biotype or gingival recession. In this study, a higher percentage of females had thin biotype compared with males, which was similar to studies by Bhat and Shetty (25) and Vandana (26). In this study, the mean age of patients with thin biotype was lower than thick biotype. This result was similar to the results of Mousavi et al (27). However, Vandana (26) and Van der Velden (28) reported that the gingival mucosa was thicker in younger patients. This discrepancy may be due to differences in the study populations and the method of measuring the gingival thickness. A previous study showed that the thickness of the epithelium and the degree of keratinization decreased with age. On the other hand, connective tissue became denser with age (29).

One limitation of this study was poor cooperation of patients that decreased the number of sample size due to the COVID-19 pandemic.

Conclusion

The thickness of tuberosity mucosa was greater than the palatal mucosa, but its volume is smaller for tissue harvesting. In the palatal mucosa, the canine-premolar region has optimal thickness for harvesting and safe distance from important anatomical landmarks.

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