



## Palatal Mucosal Thickness Variation in Maxillary First Premolar in a Group of Thai Measured from CBCT Image

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### Abstract

An autologous connective tissue graft from the palate is one of the most predictable donor sites for mucogingival periodontal surgery. The thickness of palatal mucosa varied among ethnicity could dictate the treatment outcome.

This study aimed to analyze the palatal masticatory mucosal thickness variation in maxillary first premolars by using cone-beam computed tomography (CBCT) images in a group of Thai participants.

From 900 CBCT images, there were only 20 cases included in this retrospective study. The systematic measuring of 160 points of the palatal mucosal thickness was performed at four points (3-, 6-, 9-, and 12-mm) both left and right sides of the maxillary first premolar on the CBCT images, starting from 3 mm below cemento-enamel junction (CEJ) and in 3-mm intervals (3-, 6-, 9-, and 12-mm) from the CEJ of permanent maxillary first premolars. The radiographic measurements were performed by calibrated experience oral radiologist and periodontist. Descriptive data were analyzed to determine the differences in the mucosal thickness according to the sides of the palate and gender. Independent T-test and ANOVA were utilized to analyze the thickness related to the gender and differences in thickness interval.

There was a perfect agreement of inter-rater reliability between observers ( $>0.9$ ). The means of the right palatal mucosal thickness at 3-, 6-, 9-, and 12-mm were  $3.03 \pm 0.82$ ,  $3.79 \pm 0.53$ ,  $3.97 \pm 0.91$ , and  $3.74 \pm 1.02$ , respectively, and on the left side were  $3.48 \pm 0.76$ ,  $4.10 \pm 0.49$ ,  $4.51 \pm 0.81$ , and  $3.94 \pm 1.11$ , respectively. There was no statistical difference in the mucosa thickness observed by side and gender. On the contrary, the palatal masticatory mucosa significantly increased gradually from the CEJ toward the apical region ( $p < 0.05$ ). The maximum palatal mucosal thickness was at 9-mm on both left and right sides and declined at 12-mm.

The palatal mucosal tissue from the maxillary first premolars represented uneven thickness that increased gradually from the CEJ toward the apical region. There was no difference by side and gender.

**Keywords:** *palatal mucosa, thickness, CBCT, maxillary premolar, Thai*

### 1. Introduction

The palatal masticatory mucosa is the main donor area of the soft tissue graft applied for increasing the dimensions of keratinized mucosa around teeth and implants, covering exposed roots, and increasing localized alveolar ridge thickness which reported high success rates (Prato, Clauser, & Cortellini, 1995). In most mucogingival surgery, the quantity of the palatal masticatory mucosa dictates the treatment plan and affects the surgical outcome (Monnet-Corti et al., 2006). The variation in terms of size and shape of the palatal vaults was suggested to influence the dimensions of the donor tissue harvested (Reiser, Bruno, Mahan, & Larkin, 1996). A direct physical method by bone sounding using an endodontic reamer or periodontal probe is one of the methods to measure the palatal mucosal thickness. However, this technique presents a great drawback since it requires local anesthesia, and thus, it is commonly performed just before the graft is harvested, not allowing precise presurgical planning of the procedure. A non-invasive method that applies an ultrasonic device has also been described; however, this method presents a certain degree of difficulty to consistently obtain reliable results, especially in thick areas (Lee, 2012). Cone-beam computerized tomography (CBCT) has been widely used recently to analyze the maxillofacial region. The CBCT technology offers dentists high-quality diagnostic images, and it has become an essential tool in dentistry. The CBCT could be applied for visualizing and assessing the palatal mucosal thickness (Song et al., 2018).



The clinicians should concern the potential risks of harming vital structures in that region while collecting the graft. Many studies suggested that the palatal donor tissues from the area between the first premolar and the first molar have now become a safe zone for harvesting (Benninger, Andrews, & Carter, 2012; Ikuta et al., 2013; Tomaszewska et al., 2014). The most common site for harvesting was at the first premolar due to a low risk of damaging vital structures. To date, only a few reports are available on the thickness of the palatal mucosa in dentate individuals, and due to the inadequacy of data in the Thai population, this study was performed.

## 2. Objectives

- 1) To assess the palatal mucosal thickness at the maxillary first premolars.
- 2) To evaluate the effect of side and gender on the palatal mucosal thickness at different positions.

## 3. Materials and Methods

### 3.1) Sample selection

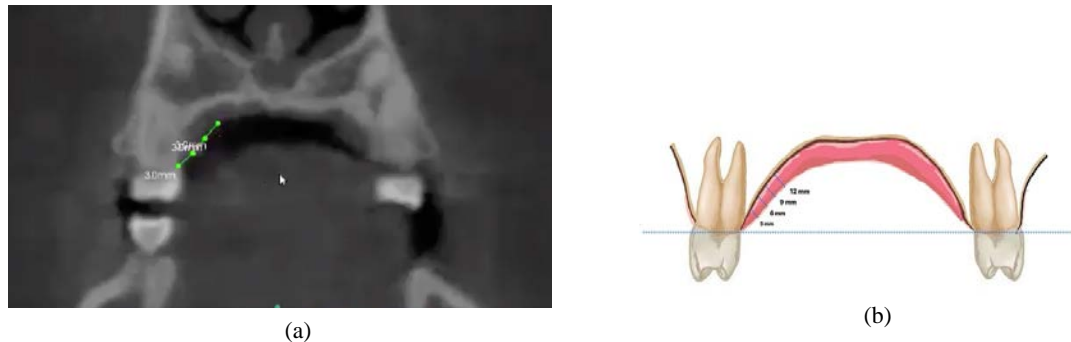
The review of the patient's CBCT images was approved by the University's Ethical Board (RSUERB2020-043). Out of 916 CBCT images taken between 2008 and 2020, there were only twenty patient's CBCT images (ten males and ten females) with full permanent maxillary posterior teeth, and the absence of scattering artifacts could be included in this retrospective study. All of them were recruited from the Department of Radiology, College of Dental Medicine, Rangsit University (Pathum Thani, Thailand), using purposive sampling. The palatal mucosal thickness was performed at four points (3-, 6-, 9-, and 12-mm) on both left and right sides of the maxillary first premolar on the CBCT images, starting from 3 mm below the CEJ and in 3-mm intervals (3-, 6-, 9-, and 12-mm) from the CEJ of permanent maxillary premolars.

### 3.2) Tools of measurement

The CBCT images were taken using I-CAT (Imaging Sciences International, Hatfield, PA, USA) machine and saved as DICOM files. The analysis was carried out using the software program CS3D (Carestream Dental LLC, Atlanta, GA, USA). The occlusal plane was position horizontally to the scan plane. The mid-sagittal plane was at the center. The images were obtained at 70 to 74 kV, 10 mA, and 10.8 s with a voxel size of 200-250  $\mu\text{m}^3$ . The field of view (FOV) size is 50 mm  $\times$  37 mm with a 200- $\mu\text{m}$  image resolution. All field of view (FOV) sizes were included in the study if central incisor and ICC appeared. The CBCT slice thickness is 0.18 mm on the CBCT with a slice interval of 1.6 mm. The images were evaluated by two observers; the first is an experienced radiologist and the second is a periodontist who has experience of more than twenty years. To assess intra-observer consistency, the measurements were re-evaluated and recorded as blind to the first measurements a month later.

### 3.3) Measurement of palatal mucosal thickness

In the coronal plane, the integration was set to 250 micrometers slice thickness. Three millimeter-interval sections were drawn along to the palatal mucosal outline (3-, 6-, 9-, and 12-mm) started from the CEJ. The mucosal thickness was recorded at each point by the distance measured from the palatal bone perpendicular to the palatal mucosa (Figure 1). The descriptive data were analyzed to determine the differences in the mucosal thickness according to the sides of the palate and gender. Independent t-test and ANOVA were utilized to analyze the thickness related to the gender and differences in thickness interval.



**Figure 1** The coronal view of the CBCT images represents (a) lines along to the palatal mucosa at each 3-mm interval (3, 6, 9, and 12 mm), (b) palatal mucosal thickness at each point from palatal bone perpendicular to palatal soft tissue.

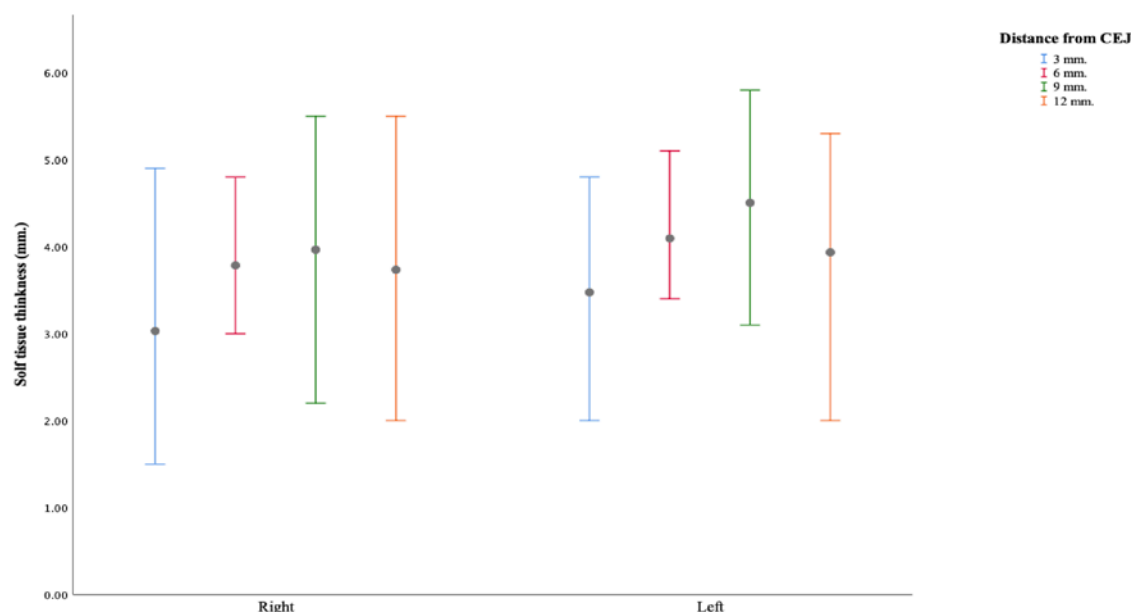
#### 4. Results and Discussion

The mean thickness of the palatal mucosa at the first premolar was shown in Table 1. The maximum palatal mucosal thickness was at 9 mm on both left and right sides. The thickness tended to increase from the coronal to apical region (3-, 6-, and 9-mm); however, a decrease in thickness at 12-mm was observed. Furthermore, there was no difference in the thickness between the left and right sides at the same level of the measurement. At the right side, the mucosal palatal thickness at 3-mm was significantly different from at 6-, 9-, and 12-mm. As for the mucosal palatal thickness at 6-, 9-, and 12-mm were not significantly different. On the left side, the mucosal palatal thickness at 3-mm was significantly different from at 9-mm but the thickness at 6-, 9-, and 12-mm were not significantly different.

**Table 1** Means and standard deviations of the palatal mucosal thickness

Palatal mucosal thickness	Right			Left		
	Male	Female	Total	Male	Female	Total
<b>3 mm</b>	2.66 (0.74)	3.40 (0.76)	3.03 (0.82) <sup>a,b,c</sup>	3.16 (0.50)	3.79 (0.86)	3.48 (0.76)*
<b>6 mm</b>	3.74 (0.50)	3.83 (0.60)	3.79 (0.53) <sup>a</sup>	4.04 (0.49)	4.15 (0.51)	4.10 (0.49)
<b>9 mm</b>	4.17 (0.87)	3.76 (0.94)	3.97 (0.91) <sup>b</sup>	4.55 (0.74)	4.46 (0.90)	4.51 (0.81)*
<b>12 mm</b>	3.88 (1.03)	3.59 (1.05)	3.74 (1.02) <sup>c</sup>	3.78 (1.14)	4.09 (1.11)	3.94 (1.11)
<b>Total</b>	3.61 (0.97)	3.88 (0.89)	3.63 (0.90)	3.65 (0.84)	4.12 (0.87)	4.00 (0.90)

\*, a, b, c, d Statistically significant difference ( $p < 0.05$ )



**Figure 2** Variation of palatal mucosal tissue thickness among regions 3-, 6-, 9-, and 12-mm on both right and left sides.

In many studies, the palatal mucosal thickness increased gradually from the CEJ toward the apical region (Cho, Yu, Lee, Lee, & Kim, 2013; Song et al., 2008), which correlated with this study. In this study, the authors also used the CBCT to assess the palatal soft tissues similar to Song et al., 2008; Ueno et al., 2013; Yilmaz et al., 2015; Hormdee et al., 2020. However, there are differences in the mucosal thickness at the maxillary first premolar, which could be explained by the differences in measurement methods. Yilmaz et al. (2015) utilized the same measurement method as this study. Yilmaz et al. (2015) found that the thickness at 3-, 6-, and 9-mm below the CEJ were 2.2(0.92), 3.1(0.68), and 3.8(0.64) mm, respectively. Overall, their data indicated a thinner mucosa than in the present study. These differences may be attributable to the age and ethnicity of the study. In this study, there was a tendency of greater thickness at 6- and 9-mm compared with at 3-mm. The thinnest palatal mucosal thickness was at 3-mm. The maximum palatal mucosal thickness was at 9-mm on both left and right sides and declined at 12-mm (Figure 2), which is consistent with the study conducted in the Japanese population (Ueno et al., 2014). However, our result was inconsistent with the study performed in the Korean population (Song et al., 2008).

A subepithelial connective tissue graft is normally taken horizontally from the first premolar to the second molar (Hormdee et al., 2020). The height depends on the type of palatal vault, which the study suggested that if the clinicians stayed within 75% of the distance between the CEJ (Benninger, Andrews, & Carter, 2012) and the most superior point of the hard palate, they might be able to avoid the damage to the vital structures. Further study should include multiple areas perpendicular to each maxillary posterior teeth. As a result, the prediction of the autologous connective tissue graft outlines in three dimensional will be better predicted the surgical outcomes. However, the sample size was the limitation of this study

## 5. Conclusion

The palatal mucosal thickness in the maxillary first premolars was consistent on both sides and increased gradually from the CEJ toward the apical region, but not affected by gender. The region of 3- to 9-mm below the CEJ appeared to be the appropriate donor area to harvest autologous subepithelial connective tissue graft because of its sufficient thickness for improving the surgical outcomes.



## 6. References

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