Assessment of Hard Palate Mucosal Thickness in Vietnamese and Related Factors

Lam Nguyen Le[1]*, Ninh Thanh To[2], Khanh Phuong Vu Le[2]

1. Department of Pediatrics and Orthodontics, Faculty Odonto-Stomatology, Can Tho University of Medicine and Pharmacy, Viet Nam.
2. Faculty Odonto-Stomatology, Can Tho University of Medicine and Pharmacy, Viet Nam.

Abstract

Connective tissue graft in combination with a coronally advanced flap is considered the gold standard for the treatment of gingival recession and soft tissue augmentation around tooth and implant. The palatal masticatory mucosa is the main donor area of connective tissue graft.

To measure the thickness of the hard palate mucosal of Vietnamese adults on Cone Beam Computerized tomography (CBCT) image and influencing factors.

48 periodontally, healthy dentate Vietnamese adults are CBCT taken with an acrylic X-ray guide stent. Thicknesses of palatal masticatory mucosa of the canine, first and second premolar, first and the second molar are measured on CBCT image at various points distanced from gingival contour 2mm, 5mm, 8mm. Some parameters such as age, gender, BMI index, and gingival genotype are also obtained.

The mean thickness of palatal masticatory mucosa in Vietnamese adults is 2.99±0.84mm. No significant difference was found between age group, gender, group below and above average BMI, and gingival genotype. The mean thickness of palatal masticatory mucosa of canines (3.23±0.74), first premolars (3.07±0.75), and second premolars (3.18±0.87) are significantly higher than those of first molars (2.75±0.76) and second molars (2.72±0.91) (p<0,05).

In the absence of an X-ray guide stent, CBCT might be regarded as a non-invasive technique for precise and repeatable measuring of the hard palate mucosal thickness. First premolars, second premolars, and canines were the best areas to obtain connective tissue grafts from.

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Introduction

Connective tissue graft in combination with a coronally advanced flap is considered the gold standard for the treatment of gingival recession and soft tissue augmentation around tooth and implant. The palatal masticatory mucosa is the main donor area of connective tissue grafts[1-3]. The hard palate mucosal is the region that receives connective tissue grafts the most frequently[4]. In defining the proper course of therapy, prognosis, viability of the graft, mode of healing, and clinical outcome of gum surgery - mucosa, the thickness of the collected connective tissue grafts is crucial[5,6]. A successful soft tissue graft requires at least 3 mm of palatal mucosa in the area where a connective tissue graft is to be applied[7]. To properly execute connective tissue grafting treatments in the palatal region, it is crucial to measure the thickness of the palatal mucosa.

The hard palate mucosa can be measured in a variety of ways, including invasive and non-invasive techniques including computed tomography, ultrasound, and histological assessment. Other procedures include measuring with a needle or endodontic file while sedated. The drawbacks of each of these approaches vary[8]. Cone Beam Computed Tomography (CBCT) has gained prominence in the maxillofacial profession, and studies have used CBCT to gauge the average thickness of the hard palate mucosa in the general population. Brazilian, Indian, Chinese, and Japanese populations as well as the findings demonstrate

Corresponding author:
Lam Nguyen Le, DDS, MSc, PhD
Vice Dean, Faculty of Odonto-Stomatology,
Head of Department of Pediatrics and Orthodontics,
Can Tho University of Medicine and Pharmacy,
Can Tho city, Vietnam.
E-mail: lenguyenlam@ctump.edu.vn

that CBCT is an accurate, dependable, and non-invasive way to measure the thickness of the hard palate mucosa[9-12].

Materials and methods

Study subjects and study design

A cross-sectional descriptive study on the adult Vietnamese population. Sampling criteria include participants who agree to take part in the study, have Vietnamese nationality, all family members are Vietnamese, are between the ages of 18 and 45, have enough teeth in the canine region to reach the second molar on both sides of the upper jaw, and have healthy periodontal tissue. Patients who meet the following criteria are excluded: those who smoke regularly, have had palatal surgery in the past or present, are wearing removable prostheses or maxillary orthodontic appliances, have severely crowded teeth in the canine to the second molar region of the upper jaw, have a lot of misaligned teeth, or have sparse tooth development, and pregnant women are also excluded.

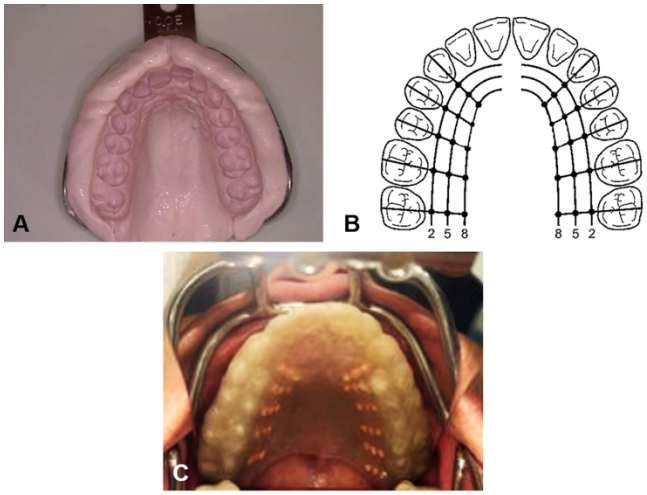

Figure 1. (A) Alginate impression of the complete maxilla (including the hard and soft tissues). (B) On the palatal side of teeth 3, 4, 5, 6, and 7, the holes are located 2, 5, and 8 mm from the gingival margin's center, respectively. (C) Fill these holes with a gutta-percha endodontic cone to produce contrast markers on CBCT.

The same skilled technician used a Dentsply Sirona Orthophos SL with the same 110KVp and 15mA for 36s during the second appointment to do CBCT scans on all research participants while they were all wearing intraoral troughs (voxel size: 0.25mm). The researcher used pictures created from CBCT scan data using Sidexis 4 software to quantify the mucosa's thickness in a horizontal plane perpendicular to the palatal mucosal surface at places of 2mm, respectively. 5mm, 8mm. Each subject will therefore undergo 30 measurements. On the research participant information sheet, details about the study participants' age, weight, BMI, and gingival phenotype were also noted (Figures 2, 3).

Model preparation

The Can Tho University of Medicine and Pharmacy's Ethics Committee in Biomedical Research accepted this study with a vote of 114/PCT-HĐĐĐ. The researcher looked at epidemiological characteristics and took alginate impressions of the complete upper jaw (hard and soft tissue) from each study participant at the initial consultation. Then, a 0.5mm thick transparent acrylic film trough was created based on the hard plaster cast of the specimen, and it was perforated from the midpoint of the gingival margin on the palatal side of teeth 3, 4, 5, 6, and 7 at distances of 2, 5, and 8mm, respectively. To produce contrast landmarks on CBCT, plug these holes with a gutta-percha endodontic cone (Figure 1).

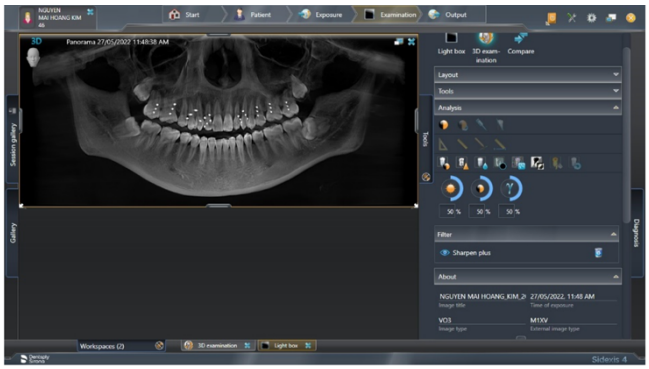

Figure 2. Image of the Sidexis 4 software interface.

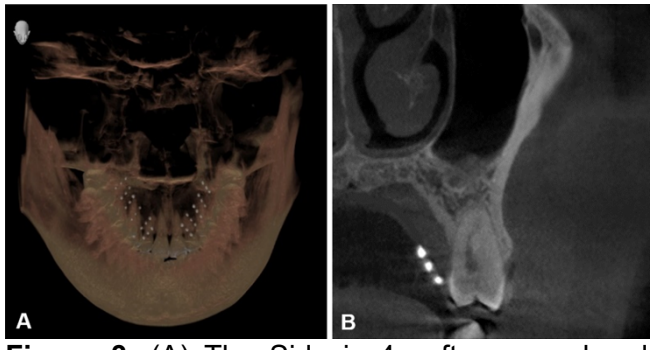

Figure 3. (A) The Sidexis 4 software-rendered

3D CBCT image, the 2, 5, and 8mm positions are indicated with gutta-percha in. (B) The iconic CBCT image of the positions at 2,5.8mm on the coronal plane.

Statistical analysis

SPSS software 22 is used for data processing. When comparing the findings of palatal mucosal thickness between age groups, sexes, arch 1 and 2, the group under index, and on average BMI using an independent t-test, the gingival phenotypic is thick and thin. ANOVA test is used to compare the average results of mucosal thickness between teeth (3,4,5,6,7) and positions (2,5,8) of mm, and the Tukey test is used to compare the average results of mucosal depth at 2 different locations with different degrees of significance ($p < 0.05$).

Results

As a result, 48 persons, comprising 25 males (52.08%) and 23 women (47.92%), satisfied the sample requirements and consented to take part in the study. The participants in the research had an average age of 33.06±6.26, with 28 persons in the 30-45 age group (56.25%) and 21 in the 18-29 age group (43.75%). The BMI of the individuals in the research was 22.32 on average.

The hard palate mucosa's average thickness was the same in quadrants 1 and 2, there was no difference (Table 1). The palatal mucosa's thickness increased as the measuring location moved further away from the gingival contour, which was a statistically significant difference at the measurement site ($p<0.001$). At the location of the canine's 8mm, the palatal mucosa was the thickest (3.78±0.58). At the location 5mm of the second molar (2.34±0.74), the palatal mucosa's thickness was the thinnest. Sites with a palatal mucosal thickness of more than 3 mm included positions B (5 mm), C (8 mm) of the canine, C (8 mm) of the first premolar, B (5 mm), C (8 mm) of the second premolar, and position C (8 mm) of the first and second molar (Table 2). In comparison to the first molar position (2.75±0.76), the canine position had a thicker hard palate mucosa on average (3.23±0.74), and the second molar position (2.72±0.91) was statistically significant ($p=0.001$). The average hard palate mucosa thickness was greater at the position of the first premolar (3.07±0.75) than the first molar (2.75±0.76), and the position of the second molar (2.72±0.91) was statistically significant ($p=0.001$). The second premolar position had a thicker hard palate mucosa on average (3.18±0.87) than the first molar (2.75±0.76), and the second molar position (2.72±0.91) was statistically significant ($p=0.001$) (Table 3). Patients who were male had a greater rate (52.08% vs. 47.92%) than those who were female. Men and women, as well as groups with thick and thin periodontal biotypes, did not differ in the mean thickness of the hard palate mucosa (Table 4). Between the groups with shallow and deep palate shapes for the mean for all teeth, there was no statistically significant difference in the thickness of the hard palate mucosa. The thickness of the hard palate mucosa between men and women for positions from the canine to the second molar except for the first molar did not differ statistically significantly for any individual tooth. However, the palatal mucosa thickness in the deep group for the first molar (2.80±0.98) was statistically larger than in the shallow group (2.63±0.82) ($p=0.02$) (Table 5). Age and mean palate mucosal thickness was not correlated. There was also no relationship between age and the thickness of the palatal mucosa in the location from the canine to the second molar for any particular tooth (Table 6).

There was a marginally significant connection between BMI and the average palatal mucosal thickness across all teeth ($p=0.005<0.01$, $r=0.074$). There was no relationship between age and the thickness of the palatal mucosa in any tooth location from the canine to the second molar, except for the first molar. However, there was a marginally positive connection between BMI and the mean palatal mucosal thickness of the first molar ($p=0.03<0.05$, $r=0.126$) (Table 7).

The thickness of the hard palate mucosal	Position		Mean ± SD (mm)	p
	Quadrant 1 (mm)	Quadrant 2 (mm)		
	2.99 ± 0.83	2.99 ± 0.84	2.99 ± 0.84	0.857

Table 1. The average thickness of the hard palate mucosa in each quadrant.
(Independent t-test)

The thickness of the palatal masticatory mucosa		Mean ± SD	p
Canine	A	2.65 ± 0.59	
	B	3.26 ± 0.60	
	C	3.78 ± 0.58	
First premolar	A	2.44 ± 0.42	
	B	2.98 ± 0.58	
	C	3.07 ± 0.75	
Second premolar	A	2.48 ± 0.50	
	B	3.08 ± 0.66	0.001
	C	3.19 ± 0.87	
First molar	A	2.45 ± 0.56	
	B	2.59 ± 0.69	
	C	3.21 ± 0.79	
Second molar	A	2.45 ± 0.53	
	B	2.34 ± 0.74	
	C	3.35 ± 1.01	

Table 2. Measurement of the palatal masticatory mucosa was performed from the maxillary canine to the second molar on one side at A. 2 mm, B. 5 mm, and C. 8mm from the gingival margin.
(ANOVA test)

Position (mm)	Canine (3.23±0.74)	First premolar (3.07±0.75)	Second premolar (3.18±0.87)	First molar (2.75±0.76)	Second molar (2.72±0.91)
Canine (3.23±0.74)		0,132	0,964	0,001	0,001
First premolar (3.07±0.75)	0,132		0,448	0,001	0,001
Second premolar (3.18±0.87)	0,964	0,448		0,001	0,001
First molar (2.75±0.76)	0,001	0,001	0,001		0,98
Second molar (2.72±0.91)	0,001	0,001	0,001	0,98	

Table 3. P-value when comparing the hard palate mucosa's mean thickness at the positions of the canines and second molars.
(ANOVA test and Turkey test)

Demographic variables	n	%	Thickness (mm)	p
Sex				
Male	25	52.08	2.97 ± 0.82	0.08*
Female	23	47.92	3.00 ± 0.86	
Periodontal biotype				
Thin	24	50	2.97 ± 0.85	0.34*
Thick	24	50	3.01 ± 0.82	

Table 4. Measurement of the palatal masticatory mucosa was performed from the maxillary canine to the second molar according to socio-demographic variables.
(Chi-square test (χ2)

Position	Palatal shape		p
	Shallow palate	Deep palate	
Canine	3.26 ± 0.79	3.20 ± 0.69	0.07
First premolar	3.03 ± 0.71	3.12 ± 0.80	0.15
Second premolar	3.17 ± 0.86	3.20 ± 0.89	0.50
First molar	2.63 ± 0.82	2.80 ± 0.98	0.02
Second molar	2.77 ± 0.74	2.73 ± 0.78	0.35
Mean ± SD	2.97 ± 0.82	3.00 ± 0.86	0.11

Table 5. Measurement of the palatal masticatory mucosa was performed from the maxillary canine to the second molar according to palatal shape.
(Independent t-test)

Position	r	p
Canine	-0.007	0.91
First premolar	-0.007	0.91
Second premolar	-0.067	0.26
First molar	-0.06	0.03
Second molar	0.008	0.89
Mean	-0.026	0.32

Table 6. Measurement of the palatal masticatory mucosa was performed from the maxillary canine to the second molar according to age.
(Pearson's correlation, *Correlation, ** Moderate correlation)

Position	r	p
Canine	0,057	0,33
First premolar	0,050	0,40
Second premolar	0,071	0,23
First molar	0,126	0,03*
Second molar	0,079	0,18
Mean	0,074	0,005**

Table 7. Measurement of the palatal masticatory mucosa was performed from the maxillary canine to the second molar according to BMI.
(Pearson's correlation, *Correlation, ** Moderate correlation)

Discussion

Assessment of hard palate mucosal thickness in Vietnamese

There were discrepancies in the results between research, which may have been brought about by variations in ethnicity, sampling methods, age of study participants, and palatal mucosal assessment technique. In line with studies by Barriviera et al. and Said et al., there was no variation in mucosal thickness between the right and left sides [9, 13].

The mean thickness of the hard palate mucosa at the canine position (3.23±0.74) reduced somewhat while moving to the first premolar position (3.07±0.75) and increased again when moving to the second premolar position (3.18±0.87), but this difference was not statistically significant. The mean thickness of the hard palate mucosa at the second premolar position reduced dramatically as it reached the first molar position (2.75±0.76); this difference was statistically significant. There was no difference in the mean thickness of the hard palate mucosa at the first and second molar positions (p=0.98) (Table 3). Significantly, the

mean palatal mucosal thicknesses of canines, first molars, and second molars are all more than 3mm, which was recommended by Harris in 1992 [7] to assure a successful connective tissue grafting surgery. This conclusion was also consistent with Puri et al's recommendation in a review of the literature on connective tissue grafts in 2019 that the palatal region from the distal canine to the proximal first molar was an effective connective tissue grafting area, but it was necessary to measure transgingival before performing surgery to ensure that the tooth in the grafting area was at least 3mm thick [4].

Most teeth were less than 3mm thick in locations A, which measured 2mm. Positions B (5mm), and C (8mm) of the canines; position C (8mm) of the first premolar; position C (8mm) of the first and second molars were discovered on the hard palate mucosa as being appropriate for connective tissue grafting sites with palatal mucosal thickness more than 3mm.

The results were in line with the research done by Barriviera et al. in 2009 when the palatal area was examined at the location. The thickness of the palatal mucosa was the thinnest at position B (5mm) of the second molar (2.34±0.74). Anatomical alterations such as bony protrusion and a thin palate mucosa may be evident in second molar placements [9].

The areas between positions B (5mm) and C (8mm) relative to the gingival contour of the first and second premolars and canines were thus determined to be the most suitable area for connective tissue grafting to ensure a successful connective tissue grafting procedure in adult Vietnamese (with a thickness of more than 3mm).

Assessment of the impact of various related factors

There was no statistically significant difference in the mean thickness of the hard palate mucosa between men and women, and this finding was compatible with research by Barriviera et al., Said et al., and Yaman et al. [8, 13, 14]. Women had statistically significantly less thickness than males, according to research by Kuriakose et al. and Song et al. [12, 15]. Women had a statistically significantly thicker hard palate than males, according to research by Schacher et al.[14]

The mean palatal mucosal thickness of the lower and upper groups on mean BMI did not differ statistically significantly; the mean palatal mucosal thickness of all teeth and BMI were similarly positively connected with the degree of weakness ($p=0.005<0.01$, $r=0.074$). This was in line with research demonstrating that mean thickness rises with BMI in the German population by Schacher et al and the Croatian population by Stipetic et al [8, 14]. However, the results of Yaman et al's investigation in the Turkish population revealed no statistically significant difference in mucosal thickness between the group with BMI below and above the median [8]. The mean palatal mucosal thickness of the first molar and BMI had a marginally positive connection for each tooth, with $p=0.03<0.05$, $r=0.126$.

Between the group with thin and thick gingival morphologies, there was no statistically significant difference in mucosal thickness. This result was consistent with the research of Said et al. [13]. The mean palatal mucosal thickness between the shallow and deep palate groups did not differ statistically significantly. This outcome was in line with Song et al's study on Koreans from 2008 [12]. However, a study conducted in 2014 by Ueno et al. on Japanese individuals using the same method of classifying the form of the palate revealed that the group with a deep palate shape had a statistically larger thickness than the group with a shallow palate shape [11]. The study population could be to blame for this discrepancy. According to Said et al. on Jordanians, those with a deep, narrow palate shape (which made up 63.3% of the study sample) had a palatal mucosal thickness that was statistically significantly higher than those with a broad, shallow palate shape (which made up 36.7% of the sample). This may be the case since, in this study, the author identified the group of palate forms by visual evaluation on a gypsum jaw sample that had been poured after the study participants' impressions had been taken. This subjective evaluation process did not ensure categorization accuracy, yielding incorrect findings [13]. For canines through the second molars, except for the first molars, there was no statistically significant difference in mucosal thickness between the group with shallow and deep palate forms. For the first molars, the thickness of the palatal mucosa was statistically significantly greater in the group with a deep palate shape (2.80±0.98) than it was in the group with a shallow palate shape (2.63±0.82) ($p=0.04$). Preparing a connective tissue graft in the area of the first molars should be taken into consideration.

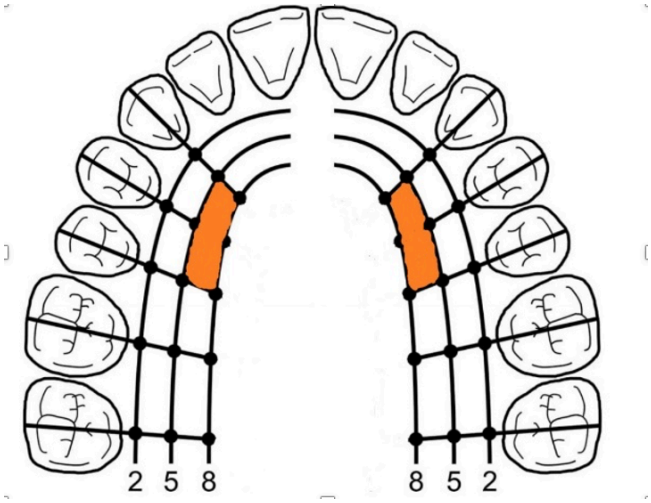

Figure 4. Suitable location for connective tissue grafts on the palate.

With the use of a radiograph, CBCT might be utilized as a noninvasive method to precisely and consistently measure the thickness of the hard palate mucosa. The hard palate mucosa of Vietnamese adults had an average thickness of 2.99±0.84 mm. In comparison to the gingival margin, the average thickness of the hard palate mucosa at locations 2, 5, and 8 mm was 2.49±0.53 mm, 2.85±0.74 mm, and 3.63±0.78 mm, respectively. The hard palate mucosa's average thickness ranged from the canines to the second molars and was 3.23±0.74, 3.07±0.75, 3.18±0.87, 2.72±0.91 mm, respectively. The regions between 5mm and 8mm above the gingival margin of canines, first and second premolars were the most suitable locations for grafting to assure effective connective tissue grafting in adult Vietnamese (greater than 3mm in thickness) (Figure 4).

Conclusions

Between quadrants 1 and 2, between genders, between the age range of 18 to 29 and 30 to 45, between the group with BMI above and below the median value, between the middle group's thick and thin gingival phenotype, or between the middle group's shallow and deep palate shape, there was no difference in the mean thickness of the hard palate mucosa. This was comparable to the hard palate mucosa thickness in each tooth, from the canines to the second molars. However, the deep palate group (2.80 ±0.98 mm) had a larger mean thickness for the first molars than the shallow palate group (2.630.82), which was statistically significant (p=0.02). In comparison to men (2.74±0.71), women (2.76±0.82) had a statistically significant thicker hard palate mucosa for the second molars (p=0.04).

Declaration of Interest

All authors have no conflict of interest relevant to this article.

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