

## Assessment of Palatal Masticatory Mucosa: A Cross-sectional Study

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### ABSTRACT

**Aim:** To treat mucogingival problems palatal masticatory mucosa is used as a donor material. This study aimed to determine the thickness of donor palatal mucosa and associations of age and gender in Indian subjects aged 14 to 60 years by direct clinical technique.

**Materials and methods:** Forty systemically and periodontally healthy Indian subjects (20 males; 20 females; age range of 14 to 60 years) enrolled in this study. Under local anesthesia bone sounding technique was performed at 15 defined and predetermined points. The Wilcoxon test was used to determine the difference in mucosal thickness between the age groups and between genders. Significance of the difference between individuals of different body mass index (BMI) was assessed by independent t-test.

**Results:** With mean thickness of 2.0 to 3.7 mm, the younger age group demonstrated significantly thinner donor mucosa (mean  $2.8 \pm 0.3$  mm) than the older age group (mean  $3.1 \pm 0.3$  mm). Within the same age group though statistically not significant; males had thicker mucosa than females. From the canine to second premolar areas and in the sites furthest from the gingival margin mucosa thickness increased. When correlated with subject's BMI, in all probed sites males demonstrated significantly a thicker mucosa than females. Within each group subjects with high BMI demonstrated thicker donor mucosa.

**Conclusion:** Current study showed that in both adult and young individuals, premolar and canine areas can be the right site for harvesting donor tissue. Even in young subjects subepithelial connective tissue (CT) graft can be harvested in adequate volume. Donor tissue thickness can be influenced by factors like genetics and race, which need to be further evaluated.

**Clinical significance:** Premolar and canine areas serve as appropriate choice to harvest palatal masticatory mucosa. Even in young patients the volume of donor tissue available is sufficient enough to consider the subepithelial CT graft procedure. Donor tissue thickness can be influenced by factors like genetics and race, which need to be further evaluated.

**Keywords:** Palatal masticatory mucosa thickness, Indian subjects, Body mass index, Subepithelial connective tissue graft, Age and sex.

**How to cite this article:** Anuradha BR, Shankar BS, John B, Prasad KARV, Gopinadh A, Devi KNN. Assessment of Palatal Masticatory Mucosa: A Cross-sectional Study. *J Contemp Dent Pract* 2013;14(3):536-543.

**Source of support:** Nil

**Conflict of interest:** None declared

### INTRODUCTION

Mucogingival problems existing around the nature teeth and implants very frequently command grafting palatal masticatory mucosa. Careful evaluation of donor tissue and right choice of the anatomical site along with strict consideration of biologic principles is of prime importance to harvest adequate volume of tissue. Anatomical knowledge and dimensions of gingiva and masticatory mucosa have become the subject of considerable interest in periodontics.

Palatal masticatory mucosa is widely used as a donor material in treating various mucogingival problems and in preprosthetic surgical procedures.<sup>1-3</sup>

The masticatory mucosa from palate/tuberosity serves as a donor material in periodontal plastic surgery.<sup>4</sup> This donor tissue is taken for various eyelid procedures,<sup>5</sup> lip reconstruction,<sup>6</sup> tracheoplasty,<sup>7</sup> and for defect closures in the tongue and cheek following tumor ablation.<sup>8</sup> In oral surgery, free grafts of the palatal mucosa are used for mandibular vestibuloplasty to increase the supportive area of the denture base.<sup>9</sup> In periodontics, free grafts of the palatal mucosa are harvested to augment the width of keratinized tissue in dentate patients,<sup>1</sup> and for surgical correction of localized alveolar ridge defects by different ridge augmentation procedures. The SECT technique<sup>10</sup> improves the ridge defect with a free connective tissue (CT) graft, which is harvested again in the hard palate/tuberosity. The roll flap technique,<sup>11</sup> and different pouch and wedge procedures<sup>12</sup> are other surgical procedures which are basically a modification of the SECT graft technique.

For ridge augmentation by soft tissue, a maximum of mucosal graft volume is harvested to correct the ridge defect and to compensate for postoperative graft shrinkage, especially with moderate and severe alveolar defect sizes.

There are few reports in the literature investigating the masticatory mucosal thickness in the anatomic regions commonly used as donor sites for soft tissue grafts. The majority of the studies determined the thickness of masticatory mucosa in edentulous patients. There are relatively few studies on the thickness of donor mucosa in partially dentate or totally dentate individuals.<sup>26-29</sup>

The thickness was also studied in descriptive manner by conventional histology on cadaver jaws.<sup>13</sup> Others assessed in edentulous subjects using invasive methods by an injection needle, macroscopic measurement of histologic sections,<sup>14</sup> a graded periodontal probe,<sup>15</sup> or cephalometric radiographs.<sup>16</sup> Noninvasive methods were performed with ultrasonic devices<sup>17-21</sup> example: a mode ultrasonic device and B-mode ultrasonic device. In contrast, the mucosal thickness of hard palate in dentate subjects was determined in few investigations.

Hence, due to limited knowledge about the masticatory mucosa thickness in the human hard palate of dentate subjects and because of its basic interest a potential donor site for soft tissue augmentation procedures, the present investigation was undertaken to determine the thickness in more details employing bone sounding technique. At the same time a possible correlation of palatal masticatory mucosa thickness with subject's body mass index (BMI), age and gender was also checked.

## AIMS AND OBJECTIVES

The aims of the present investigation is to:

1. Clinically determine the thickness of masticatory mucosa in the hard palate in healthy younger and elder age groups.
2. To compare the palatal masticatory mucosa thickness variations in both the age groups.
3. To correlate palatal masticatory mucosa thickness with subjects sex and BMI.

## MATERIALS AND METHODS

Forty healthy Asian subjects participated in the study recruited from the Department of Periodontology, HKE Society's SN Dental College, Gulbarga.

1. Younger age group: (14-29 years) 10 males and 10 females.
2. Elder age group: (30-60 years) 10 males and 10 females.

Subjects were selected as per inclusion and exclusion criteria. After receiving information about the study the subjects gave their informed consent.

## Inclusion Criteria

The inclusion criteria are healthy periodontal tissues with attachment loss and no probing depth greater than 4 mm in maxillary arch with or without third molar.

## Exclusion Criteria

The following exclusion criteria are considered as:

1. History of any palate or tuberosity surgery.
2. History of any present diagnosis of any stomatological diseases in the palate or tuberosity.
3. Pregnancy/lactation.
4. Use of any medication possibly influencing the dimensions of periodontal tissues, such as cyclosporin A, calcium channel blockers and phenytoin.
5. Wearing of any removable device in the upper arch such as a RPD/orthodontic retainer.
6. Presence of any FPD between upper canine and second molar.
7. Smoking habits.
8. Severe tooth malposition, rotation or spacing.

## First Visit

In the first visit, a maxillary arch impression was made with alginate. A study model and an acrylic stent were fabricated. Fifteen measurement points were defined and marked on the study model. A diamond bur was employed to create holes perpendicular to the surface of the stent.

## Second Visit

In the second visit, clear acrylic stent was placed on maxillary arch, and with a Gentian violet pencil all the 15 measurement points were marked through the holes prepared on the stent. The thickness of the hard palate was assessed by anesthetizing the palate with spray and then with 1.2% lidocaine, 1:1,00,000 epinephrine injection. The greater palatine nerve and incisive nerve were blocked with 0.1 and 0.05 ml of anesthetic solution, respectively. Anesthetics were injected slowly and the thickness measurements were performed thrice by the same examiner 20 minutes after the injection. The average of the three readings was taken for each. Without the stent, the thickness was measured by 'bone sounding' with an endodontic reamer with a rubber stopper attached to it. To ensure the measurement accuracy, the rubber stopper was placed in contact with the mucosal surface. The reamer with the rubber stopper securely in place was then lined up between the two prongs of digital Vernier calipers. A direct decimal readout from the display monitor was noted down when the measurement was on the rugae, the base of the measurement point. All measurements were done thrice by the same investigator with an interval of 4 minutes. At each point the final reading noted was the average of 3 readings.

Subject's BMI was calculated by measuring height in centimeters and weight in kilograms employing standardized devices. BMI was calculated employing Quetelet's formula.

Quetelet's index: weight (kg)/height square (meters).

## STATISTICAL ANALYSIS

The data were analyzed at both the site level (individual measurement point) and the subject level (mean score of 15 measurement points). The Wilcoxon test was employed to determine the difference in donor tissue thickness between the two age groups and between the genders at each

measurement point. Significance of the difference between individuals of different BMI was assessed by independent t-test.

The analyses were performed using statistical software. Statistical hypothesis tests were two-tailed comparisons at the alpha = 0.05 significance level.

## RESULTS

### Elder Age Group Females

Tables 1 to 4 and Graphs 1 to 4 present the primary data of the mucosal thickness at 15 different designated points on

**Table 1:** Mucosal thickness in elderly age group females along line A

Subject		Line A				
		Canine	1st premolar	2nd premolar	1st molar	2nd molar
Rama	A	2.6	3	3.2	1.9	2.6
Kalavati	B	2.4	2.9	3	1.8	2.5
Shobha	C	2.7	3.1	3.3	2.1	2.8
Rajamma	D	2.5	3	3.1	1.9	2.6
Shabana	E	2.8	3.2	3.5	2.2	2.8
Mahadevi	F	3	3.5	3.7	2.3	2.9
Lakshmi	G	2.2	2.8	2.9	1.5	2.2
Badi bi	H	2.3	2.9	2.8	1.7	2.3
Saroja	I	2.6	3.1	3.1	2	2.7
Haseena	J	2.9	3.4	3.4	2.2	2.9
	Average	2.6	3.09	3.2	1.96	2.63
	SD	0.244949	0.211896	0.264575	0.237487	0.228254

SD: Standard deviation

**Table 2:** Mucosal thickness in elderly age group females along line B

Subject		Line B				
		Canine	1st premolar	2nd premolar	1st molar	2nd molar
Rama	A	2.9	3.6	3.9	2.4	2.9
Kalavati	B	2.8	3.5	3.8	2.2	2.8
Shobha	C	3.1	3.8	4.1	2.6	3.1
Rajamma	D	2.9	3.6	3.9	2.4	2.9
Shabana	E	3.1	3.9	4.2	2.7	3.1
Mahadevi	F	3.4	4	4.4	2.9	3.3
Lakshmi	G	2.7	3.3	3.4	2.1	2.7
Badi bi	H	2.7	3.4	3.6	2.3	2.7
Saroja	I	3	3.7	4	2.5	3
Haseena	J	3.3	3.9	4.3	2.8	3.2
	Average	2.99	3.67	3.96	2.49	2.97
	SD	0.22561	0.219317	0.293939	0.246779	0.195192

SD: Standard deviation

**Table 3:** Mucosal in thickness elderly age group females along line C

Subject		Line C					BMI
		Canine	1st premolar	2nd premolar	1st molar	2nd molar	
Rama	A	3.6	4.1	4.7	2.7	3.2	31.6
Kalavati	B	3.5	4	4.6	2.6	3.1	31
Shobha	C	3.8	4.3	4.9	2.9	3.3	32.9
Rajamma	D	3.6	4.1	4.7	2.7	3.2	31.6
Shabana	E	3.9	4.4	5	3	3.5	33.6
Mahadevi	F	4	4.7	5.2	3.1	3.6	35.5
Lakshmi	G	3.3	3.7	4.4	2.5	3	27.5
Badi bi	H	3.4	3.9	4.5	2.5	3.1	29.3
Saroja	I	3.7	4.2	4.8	2.8	3.2	32.6
Haseena	J	3.9	4.5	5.1	3.1	3.6	33.3
	Average	3.67	4.19	4.79	2.79	3.28	
	SD	0.219317	0.280891	0.246779	0.216564	0.203961	

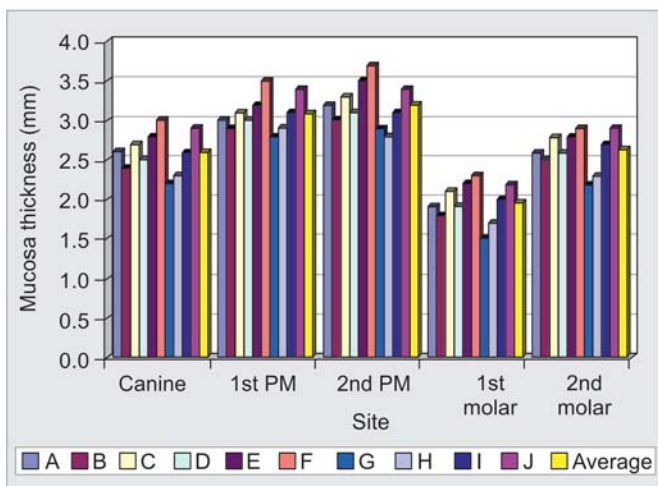
SD: Standard deviation

**Table 4:** Correlation of mucosal thickness of elderly age group females with BMI

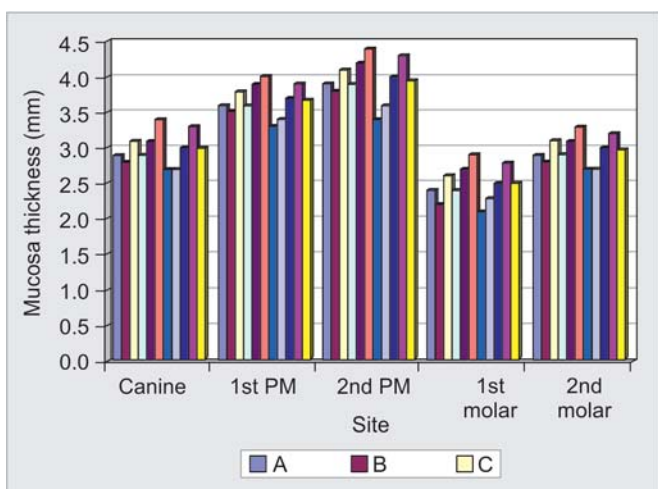
Subject	BMI	Per subject average	
Rama	A	31.6	3.153333
Kalavati	B	31	3.033333
Shobha	C	32.9	3.326667
Rajamma	D	31.6	3.14
Shabana	E	33.6	3.42
Mahadevi	F	35.5	3.6
Lakshmi	G	27.5	2.846667
Badi bi	H	29.3	2.94
Saroja	I	32.6	5.0625
Haseena	J	33.3	3.5

the hard palate of 10 elderly female patients. BMI is presented in Table 4 with individual average mucosa thickness. Mean age:  $46.8 \pm 4.3$ .

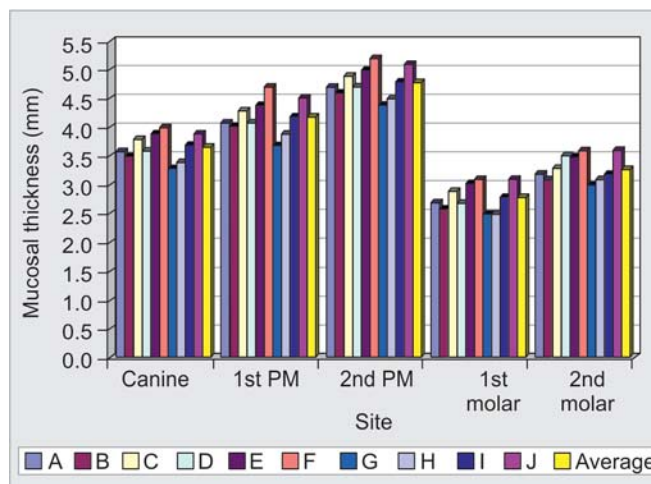
- In all the subjects the mucosal thickness increased as the measurement points moved away from gingival margin toward midpalatal line (irrespective of the tooth).
- The mucosal thickness increased from canine region (average 3.0 mm) to second premolar region (average



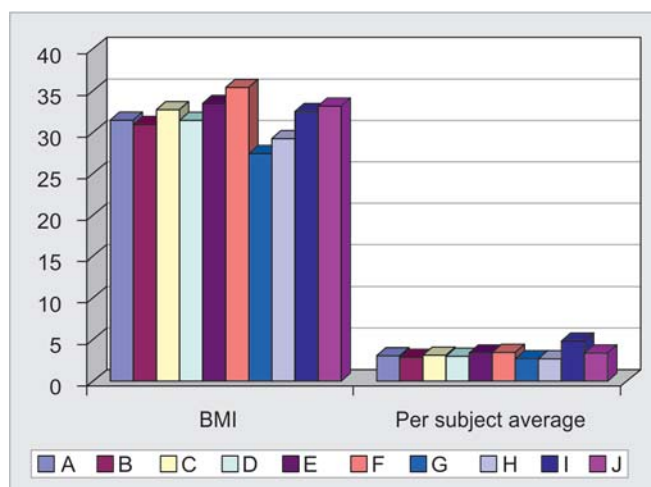
**Graph 1:** Elderly females line 'A' measurements



**Graph 2:** Elderly females line 'B' measurements



**Graph 3:** Elderly females line 'C' measurement



**Graph 4:** Elderly females BMI vs per subject average mucosa thickness

3.8 mm) and decreased in the first molar region (average 2.3 mm) and the mucosal thickness increased in the second molar region (average 2.9 mm).

- Mucosal thickness in correlation with BMI demonstrated an increased thickness in patients with increased BMI and vice versa.
- The mean thickness of the mucosa ranged between 1.96 and 4.79 mm among 10 participated elderly female subjects. Mean thickness:  $3.1 \pm 0.3$  mm.

**Elder Age Group Males**

Tables 5 to 8 and Graphs 5 to 8 present the primary data of the mucosal thickness at 15 different designated points on the hard palate of 10 elderly male patients. BMI is presented in Table 8 with individual average mucosa thickness. Mean age:  $42 \pm 8.3$ .

- In all the subjects the mucosal thickness increased as the measurement points moved away from gingival margin toward midpalatal line (irrespective of the tooth).



**Table 5:** Mucosal thickness elderly age group males along line A

Subject		Line A				
		Canine	1st premolar	2nd premolar	1st molar	2nd molar
Rajappa	A	2.8	3.1	3.4	2.2	2.9
Basappa	B	2.2	2.7	3.1	1.7	2.3
Gundappa	C	2.3	2.9	3.2	1.8	2.4
Govinda	D	2.4	3	3.3	2	2.5
Ravi	E	2.9	3.1	3.4	2.1	2.9
Hari	F	3	3.2	3.5	2.3	3
Ali	G	3.1	3.3	3.6	2.3	3.1
Naved	H	3.2	3.4	3.7	2.4	3.2
Nazeer	I	3.3	3.5	3.8	2.6	3.5
Ahmed	J	3.4	3.6	3.9	2.7	3.6
	Average	2.86	3.18	3.49	2.21	2.94
	SD	0.405463	0.263818	0.246779	0.304795	0.417612

SD: Standard deviation

**Table 6:** Mucosal thickness elderly age group males along line B

Subject		Line B					BMI
		Canine	1st premolar	2nd premolar	1st molar	2nd molar	
Rajappa		3.1	3.8	4.2	2.7	3.1	23.9
Basappa		2.8	3.4	3.6	2.3	2.9	23.8
Gundappa		2.9	3.6	3.9	2.4	2.9	25.6
Govinda		3	3.7	4	2.6	3	25.8
Ravi		3	3.8	4.2	2.7	3.1	26.3
Hari		3.1	3.9	4.1	2.8	3.2	27.5
Ali		3.1	4	4.4	2.9	3.3	27.6
Naved		3.2	4.1	4.5	3	3.4	28.9
Nazeer		3.3	4.2	4.6	3.1	3.4	30.4
Ahmed		3.5	4.3	4.8	3.3	3.5	31.3
	Average	3.1	3.88	4.23	2.78	3.18	
	SD	0.189737	0.263818	0.337787	0.292575	0.203961	

SD: Standard deviation

**Table 7:** Mucosal thickness elderly age group males along line C

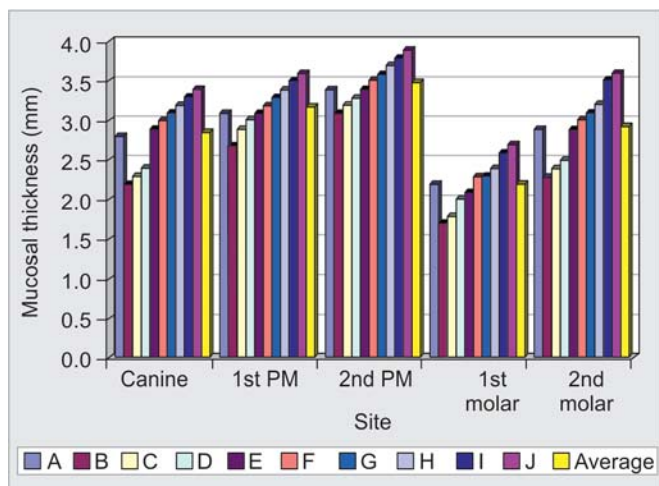
Subject		Line C					BMI
		Canine	1st premolar	2nd premolar	1st molar	2nd molar	
Rajappa		3.8	4.5	5	3	3.5	23.9
Basappa		3.3	3.9	4.7	2.7	3.2	23.8
Gundappa		3.4	4.2	4.8	2.8	3.3	25.6
Govinda		3.5	4.2	4.9	2.9	3.4	25.8
Ravi		3.8	4.5	5	3	3.5	26.3
Hari		4	4.5	5.1	3.1	3.6	27.5
Ali		4.1	4.6	5.2	3.2	3.7	27.6
Naved		4.1	4.8	5.3	3.3	3.8	28.9
Nazeer		4.2	4.8	5.4	3.4	3.9	30.4
Ahmed		4.5	5	5.5	3.5	4	31.3
	Average	3.87	4.5	5.09	3.09	3.59	
	SD	0.363456	0.31305	0.246779	0.246779	0.246779	

SD: Standard deviation

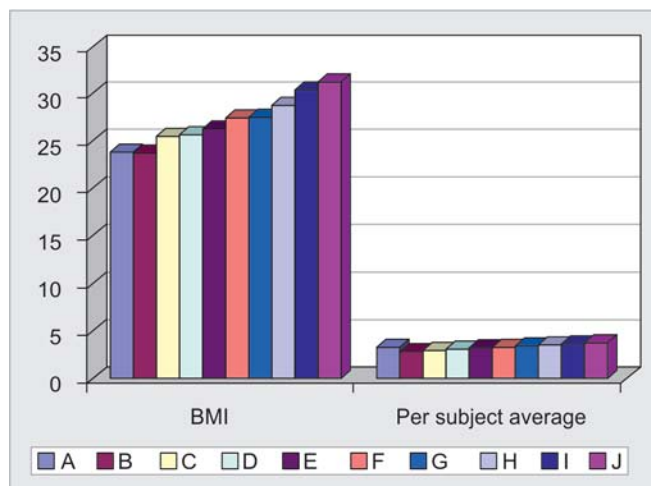
**Table 8:** Correlation of Mucosal thickness of elderly age group males with BMI

Subject	BMI	Per subject average
Rajappa	23.9	3.406667
Basappa	23.8	2.986667
Gundappa	25.6	3.12
Govinda	25.8	3.226667
Ravi	26.3	3.4
Hari	27.5	3.493333
Ali	27.6	3.593333
Naved	28.9	3.693333
Nazeer	30.4	3.8
Ahmed	31.3	3.94

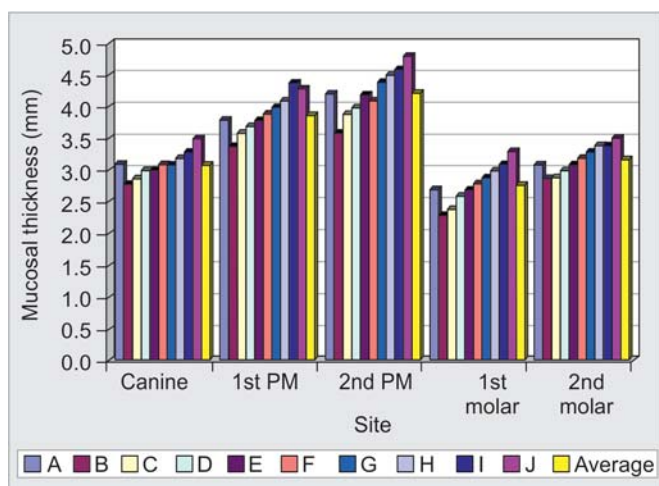
- The mucosal thickness increased from canine region (average 3.2 mm) to second premolar region (average 4.2 mm) and decreased in the first molar region (average 2.6 mm) and the mucosal thickness increased in the second molar region (average 3.1 mm).
- Mucosal thickness in correlation with BMI demonstrated an increased thickness in patients with increased BMI and vice versa.
- The mean thickness of the mucosa ranged between 2.2 and 5.0 mm among 10 participated elderly male subjects. Mean thickness:  $3.2 \pm 0.4$  mm.



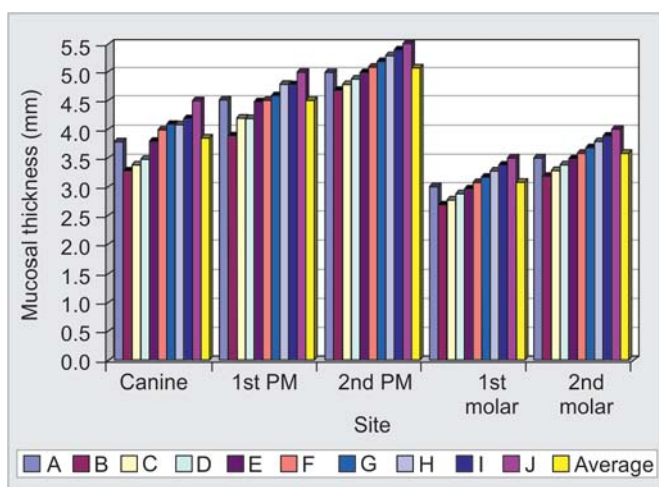
Graph 5: Elderly male line 'A' measurements



Graph 8: Elderly male BMI vs per subject average mucosa thickness



Graph 6: Elderly male line 'B' measurements



Graph 7: Elderly male line 'C' measurements

on palatal mucosal thickness in children and adolescents, young individual were included in this study. The gingival margin and the midpalatal line were used as fixed references to define 15 measurement points on the hard palate. This allowed for reliable comparison of the mucosal thickness at each measurement point between the younger and the older subject. A prepared acrylic stent was fabricated to ensure consistent locations for the repeated assessments of mucosal thickness. The results demonstrated that the mean palatal mucosa thickness ranged between 2.0 and 3.7 mm among participants and that the younger group had significantly thinner mucosa (mean:  $2.8 \pm 0.3$  mm) than the older group (mean:  $3.1 \pm 0.3$  mm). The exception was at the second molar area on line A and B, where the palatal thickness was greater in the younger group. This may be partly due to the high prevalence of exostoses present in this area in the adults.<sup>22,23</sup> It is possible that the thickness of orthokeratinized layer of the hard palate mucosa increases with age. In addition, the hard palate possesses a submucosal layer, which contains various amounts of adipose tissue and small mucous glands.<sup>24</sup>

In general, a free gingival graft is performed to correct mucogingival problems in young patients.<sup>25,26</sup> However, this procedure can lead to anesthetic results due to keloid formation and color mismatch. The SETG results in better esthetic outcome, provided sufficient volume of donor tissue is available. Present study demonstrated adequate thickness even in younger age group (range: 1.9-5.6 mm) suggesting that a significant volume of palatal donor tissue can be obtained for the subepithelial CT graft procedure. Therefore, the SETG procedure could be considered in young patients. Similar to previous reports<sup>27-29</sup> the palatal mucosal thickness adjacent to the palatal root provided limited donor tissue volume for graft harvesting. Thus, the premolar and canine areas appear to be the right donor site in both the young

**DISCUSSION**

The current study investigated the thickness of donor mucosa in Asian subjects ranging in age between 14 and 60 years. Due to the limited amount of published information

and adult individuals. The palatal neurovascular bundle, which is housed in the palatal groove and located approximately 7 to 17 mm from the CEJ of the upper premolars and molars,<sup>30</sup> may have an effect on measurement if the probe penetrates into the neurovascular structures. When the mucosal thickness at the canine and the premolar areas was compared to that compared by Studer et al in Caucasians using the same measurement method as in this study, it was found that the thickness obtained from the Asian subjects was smaller. This may be in due part to ethnic differences. Nonetheless, as in Studer's study,<sup>27</sup> the mean thickness did not differ between the males and females. The bone sounding technique, a direct clinical measurement technique used in this study has been previously suggested that this technique is relatively reliable for determining bone levels.<sup>27,31,32</sup> In the past palate area, measurement error of 0.2 mm was reported when the mucosal thickness was assessed by bone sounding.<sup>27</sup> Recently, an ultrasonic device has been introduced as an atraumatic, valid, and reliable method to measure the thickness of most parts of the oral masticatory mucosa.<sup>29</sup> However, at sites with mucosal thickness in excess of 6 mm, ultrasonic outputs may be questionable.<sup>33</sup> Muller et al found that a measurement error of 0.54 mm in the palatal mucosal thickness was examined using an ultrasonic device.<sup>29</sup> This was attributed to difficulties in locating the same measurement site, the varying thickness of the tissues and the presence of palatal rugae.

## CONCLUSION

Within the limits of present study, it is demonstrated that the mean thickness of palatal mucosa ranges between 2.0 and 3.7 mm, with no difference between the males and females, and that younger subjects have significantly thinner mucosa than older subjects. The canine and premolar areas appear to be the right donor site for grafting procedures in both young and adult individuals. The SCTG procedure could be considered as a treatment modality in young patients, because of abundant availability of donor tissue. Donor tissue thickness can be influenced by factors like genetics and race, which need to be further evaluated.

Subjects with higher BMI demonstrated increased thickness of the palatal masticatory mucosa indicating that the higher volume of CT can be harvested for periodontal surgeries. The major limitation of this study is that the sample size is not large enough to make generalizations. So, similar studies are still needed in bigger sample size to make generalizations regarding association of palatal masticatory mucosa thickness with that of age, sex and BMI in Indian subjects.

Although, assessment of the mucosa thickness in the hard palate is also available by some ultrasonic devices, the authors measuring with the above-mentioned technique did not make comparison with bone sounding technique and reported results from a small sample. Ultrasonic devices need lot of knowledge for interpretation and are still expensive for everyday practice, so simple bone sounding with a probe is still method of choice. Therefore this study concludes based on its data that in hard palate between the canine and the second premolar CT can be harvested for periodontal plastic surgeries.

## CLINICAL SIGNIFICANCE

Premolar and canine areas serve as appropriate choice to harvest palatal masticatory mucosa. Even in young patients the volume of donor tissue available is sufficient enough to consider the subepithelial CT graft procedure. Donor tissue thickness can be influenced by factors like genetics and race, which need to be further evaluated.

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