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Transgingival Probing and Ultrasonographic Methods for Determination of Gingival Thickness- A Comparative Study

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ABSTRACT

Aim: In current era of dentistry attempts are being made to perform several dental procedures quickly and atraumatically as beyond efficacy there is a need for balance and comfort for patients. Measurement of gingival thickness (GTH) has become the matter of significant interest for periodontists, orthodontists and implantologists as well. However, there are relatively few studies investigating the GTH atraumatically and rapidly.The purpose of this study was to assess and compare the two methods of determination of GTH i.e. transgingival probing (TGP) and ultrasonographic method (USG) in association with site, age, gender, tooth wise and dental arch wise in Indian population.

Methods: Thirty systemically and periodontally healthy subjects were included in the present study. Gingival thickness was assessed in the maxillary and mandibular anterior teeth by both methods.

Results: It was observed that the younger age group had significantly thicker gingiva than older age group. The gingiva was found to be thinner in females than males and in the mandibular arch than the maxilla. Within the limits of the present study it was demonstrated that thickness of gingiva varies with the tooth sites, i.e. midbuccally and interdental papillary region and also with morphology of the crown.

Conclusions: In the present study, it was concluded that GTH varies according to site, age, gender tooth and dental arch wise. In comparison to TGP method, USG method assesses GTH more accurately, rapidly and atraumatically.

Keywords: Ultrasonography, Teeth, Gingiva.

INTRODUCTION

In recent years, the dimension of different parts of masticatory mucosa, especially gingival thickness (GTH) has become the subject of considerable interest[1]. In several clinical situations, information on GTH is highly desirable.For example, a thin and delicate gingiva might be prone to developing recession after traumatic, inflammatory or surgical injuries[2]. Likewise, orthodontic tooth movement may have a

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detrimental influence on the mucogingival complex, especially at sites where the keratinized tissue and underlying bone appear to be thin[3]. In published literature majority of the studies have evaluated the thickness of masticatory mucosa by conventional histology on cadaver jaws while few others used invasive methods such as injection needle or probe[4,5], histologic sections[6], or cephalometric radiographs[7]. Though the above mentioned TGP method was invasive, non-invasive technique was performed using an ultrasonic device[1].

Technological advances affect most areas of our lives, and dentistry is not an exception. Since the discovery of X-rays by Sir W.C. Roentgen in the year 1895 a great deal of advancement has been made in the field of radiology, one of which is the introduction of diagnostic ultrasonography in the field of dentistry. The use of ultrasonography in the field of dentistry is unquestionably growing and has established itself in almost all areas of sciences and research.

With authors highlighting on the importance of GTH, efforts are being made to obtain necessary information quickly and atraumatically. Studies comparing invasive and non-invasive methods for assessing GTH are scarce. Hence in the present study an attempt has been made to compare the two methods of assessing GTH i.e. transgingival probing (TGP) and ultrasonographic (USG) methods.

Aim

The purpose of this study was to assess and compare the two methods of measuring GTH i.e. transgingival probing (TGP) and ultrasonographic method (USG) in association with site, age, gender, tooth and dental arch wise in Indian population.

MATERIALS AND METHODS

Collection of data

The study protocol had been reviewed and approved by KLE University Faculty of Dentistry's Ethical Committee. The study group included subjects with healthy gingiva in maxillary and mandibular anterior teeth. The inclusion criteria were a) healthy periodontal tissues with no loss of attachment and b) presence of all anterior teeth in both upper and lower jaw. The following exclusion criteria were considered a) destructive periodontal diseases b) pregnancy and lactation c) gingival recession in the anterior teeth d) systemic diseases e) extensive restorations f) use of any medication possibly affecting the periodontal tissues such as cyclosporine A, calcium channel blockers or phenytoin g) smokers.

Volunteers

Thirty systemically and periodontally healthy subjects who reported to the Department of Oral Medicine and Radiology at KLE V.K. Institute of Dental Sciences, Belgaum, India participated in this study. After being briefed on the procedures, all participants gave their informed consent.

The sites assessed were the GTH mid-buccally (MB) in the attached gingiva, half way between mucogingival junction and free gingival groove[8] and at the base of the interdental papilla (IDP) (Figure 1). Gingival thickness was assessed at both the measurement points tooth wise i.e. at central incisor, lateral incisor and canine by both TGP and USG methods for each selected subject. The measurement points on the buccal gingiva were marked with a water-resistant marking pencil.

Transgingival probing measurements

The gingival thickness was assessed by anaesthetizing the facial gingival with 2% lignocaine HCL with 1:80,000 adrenalin solutions. Using a UNC-15 probe GTH was assessed at the measurement points 5 minutes after injection (Figure 1). Measurements were then rounded upto the nearest millimeter. These measurements were carried out by a single periodontist.

Ultrasonic measuring device and measurements

The ultrasound B-scan (Philips HT-11), including a digital display, scan display and a transducer probe was used. The frequency was 10 MHz. Each examination was performed with the subject sitting in an upright position and the mouth

Fig 1: Intra oral photograph showing transgingival probing method using a UNC-15 probe at central incisor, lateral incisor and canine. The measurement points on the buccal gingiva were marked with a water-resistant marking pencil.

Fig 2: Ultrasonic measurements using ultrasound B-scan (Philips HT-11). The region of interest was scanned by an extra-oral probe. The transducer probe was adapted to the gingival surface coinciding with the bleeding point created during transgingival probing method.

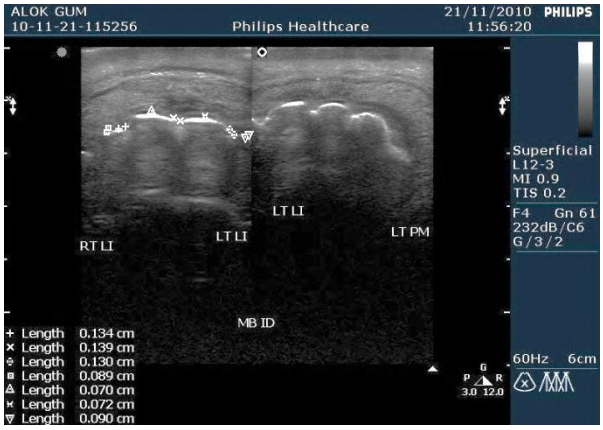


Fig 3: Ultrasonogram of maxillary anterior region.

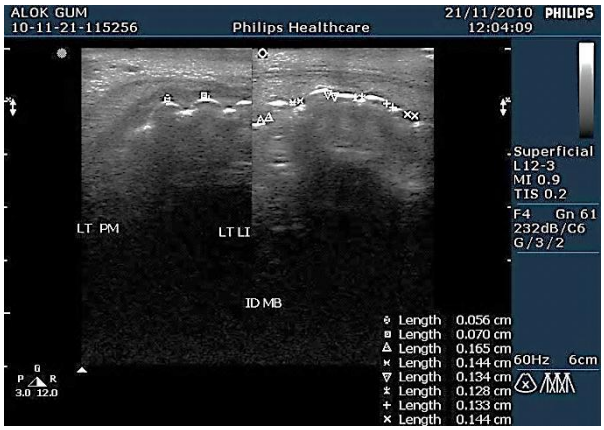
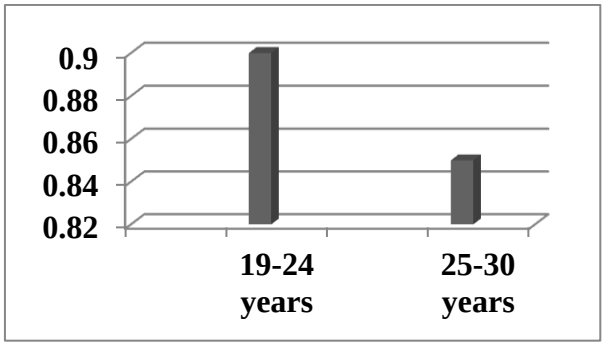
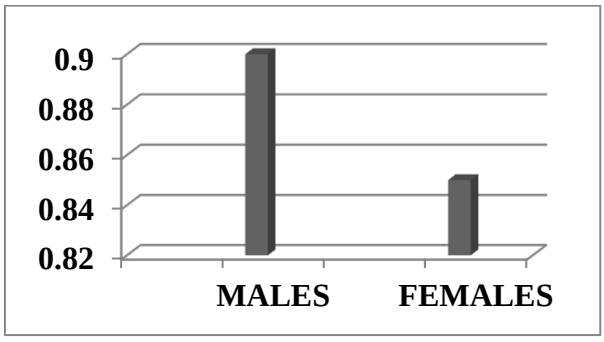


Fig 4: Ultrasonogram of mandibular anterior region.

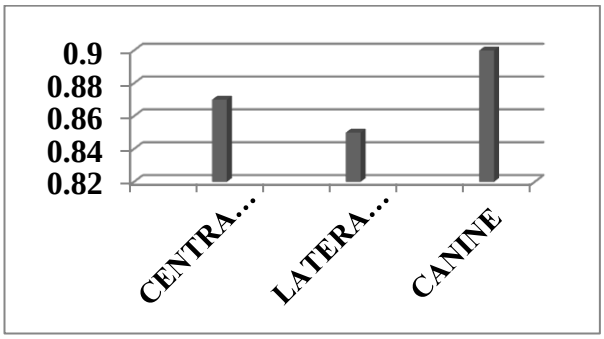


Graph 1: Mean gingival thickness (±SD) in millimetres between the younger (19-24 years) and older (25-30 years) age group midbuccally and at interdental papillary region

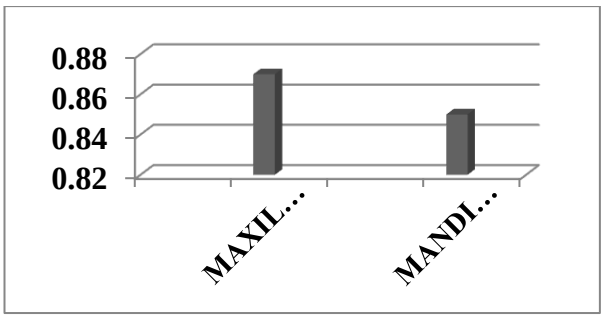


Graph 2: Mean gingival thickness (±SD) in millimetres between male and female subjects

closed. The region of interest was scanned by an extra-oral probe. In the oral cavity, water was used as sound coupling medium between the probe and selected area for examination. The transducer probe (Figure 2) was adapted to the gingival surface coinciding with the bleeding point created during TGP method. Measurements were made directly on the screen at the time of scanning (Figure 3 & 4), recorded to the nearest 0.1mm. The sonograms



Graph 3: Tooth wise comparison of TGP and USG measurements midbuccally and at interdental papillary region



Graph 4: Dental arch wise comparison of TGP and USG measurements

were performed by a single experienced radiologist.

Statistical analysis:

Unpaired 't' test was applied for statistical analysis of the data.

RESULTS

This study included thirty systemically and periodontally healthy subjects (15 males; 15 females; age range 19-30 years). A total of 720 sites were assessed in the anterior segment of the oral cavity with maximum of 24 sites for each selected subject. The measurements were recorded according to site, age, gender, tooth wise and dental arch wise and the results were as follow:

The measurements done by both the methods are illustrated in Tables and Graphs 1 to 4.

1) Site wise comparison by the two methods i.e. TGP and USG showed that the mean difference in midbuccal region was 0.02 for maxillary arch and in mandibular arch the mean difference was 0.05 which was significant ($p<0.001$) for both the dental arches. The mean difference of 0.01 was recorded at the interdental papillary region in both maxillary and mandibular arches which was also statistically significant ($p<0.001$). (Table 1)

2) The younger age group (age 19 to 24 years) consisted of 15 subjects with a mean age of 22 years, whereas the older age group (age 25 to 30 years) consisted of 15 subjects with a mean age of 28 years. Age wise comparison of GTH between TGP and USG methods at both the sites indicated that the gingiva was significantly thicker in the younger age groups than the older age group (Table 2 & Graph 1).

3) Gender wise comparison showed that the female subjects had thinner gingiva than males at the midbuccal region. At interdental papillary region, female subjects had significantly thicker gingiva than males when assessed by both the methods (Table 3 & Graph 2).

4) Tooth wise comparison of GTH between the two methods showed that thickness of gingival varied between the central incisor, lateral incisor and canine. The difference between the two methods was found to be significant both at the midbuccal and interdental papillary region, but the differences were insignificant at mandibular central incisor and lateral incisor at the midbuccal site. At the interdental papillary region, the differences were insignificant at mandibular lateral incisor and canine (Table 4 & Graph 3).

5) On comparing the GTH dental arch wise by both the methods, maxillary arch showed a thicker gingiva at midbuccal site as compared to the mandibular arch whereas at interdental papillary region, maxillary arch showed a thinner gingiva as compared to the mandibular arch (Table 1 & Graph 4).

DISCUSSION

The gingiva is that portion of the oral mucous membrane which, in a complete post-eruptive dentition of a healthy individual surrounds and is attached to the teeth and the alveolar processes. Normally, there is considerable variation in both width and thickness of the gingiva, a fact

Table 1: Comparison of TGP and USG measurements site wise i.e., midbuccally and at interdental papillary region.

Method	Dental arch	Midbuccally n=360 (MB)		Interdental papilla n=360 (IDP)		MB Vs. IDP
		Range (mm)	Mean ±SD	Range (mm)	Mean ±SD	p-value
TGP	Max.	0.5-2	0.87±0.07	0.5-2.5	1.05±0.21	p<0.001
	Mand.	0.5-3	0.81±0.12	0.5-2.5	1.20±0.14	p<0.001
USG	Max.	0.43-1.18	0.85±0.09	0.82-1.67	1.04±0.23	p<0.001
	Mand.	0.69-1.13	0.86±0.05	0.75-2.0	1.21±0.11	p<0.001
TGP Vs USG	Max.	Mean difference= 0.02 (p<0.001)		Mean difference= 0.01(p<0.0006)		-----
	Mand.	Mean difference= 0.05 (p<0.001)		Mean difference= 0.01(p<0.0006)		

Table 2: Mean gingival thickness (±SD) in millimetres between the younger (19-24 years) and older (25-30 years) age group at midbuccally and at interdental papillary region

Dental arch	19-24 years n=15 (Mean±SD)			25-30 years n=15 (Mean±SD)			Difference between age groups p-value
	TGP	USG	p-value	TGP	USG	p-value	
MB							
Max.	0.87±0.02	0.85±0.5	p<0.001	0.88±0.04	0.84±0.07	p<0.001	p<0.000
Mand.	0.81±0.03	0.88±0.02	p<0.001	0.82±0.02	0.85±0.07	p=0.002	p<0.001
IDP							
Max.	1.23±0.18	1.26±0.007	p=.008	1.20±0.18	1.32±0.3	p=0.012	p<0.004
Mand.	1.29±0.22	1.23±0.14	p=.01	1.19±0.27	1.19±0.16	p=1	p<0.9

Table 3: Mean gingival thickness (±SD) in millimetres between male and female subjects.

Gingival region and dental arch	Male (M) n=15 (Mean±SD)			Female (F) n=15 (Mean±SD)			M Vs. F p-value
	TGP	USG	p-value	TGP	USG	p-value	
MB							
Max.	0.87±0.02	0.90±0.02	p<0.001	0.88±0.04	0.79±0.02	p<0.001	p<0.000
Mand.	0.82±0.04	0.90±0.007	p<0.001	0.80±0.05	0.84±0.03	p<0.001	p<0.000
IDP							
Max.	1.09±0.01	1.18±0.09	p<0.001	1.35±0.02	1.39±0.21	p=0.011	p<0.01
Mand.	1.05±0.11	1.15±0.10	p<0.001	1.41±0.05	1.19±0.16	p<0.001	p<0.000

Table 4: Tooth wise comparison of TGP and USG measurements midbuccally and at interdental papillary region.

Dental arch		MB			IDP		
		TGP	USG	p-value	TGP	USG	p-value
Max.	CI	0.98±0.05	0.87±0.06	p<0.001	0.94±0.25	0.75±0.24	p<0.001
	LI	0.87±0.13	0.82±0.15	p<0.001	1.09±0.11	1.09±0.10	p=0.003
	CN	0.77±0.03	0.87±0.07	p<0.001	1.18±0.29	1.29±0.08	p=0.045
Mand.	CI	0.83±0.14	0.83±0.07	p=1(NS)	1.06±0.18	1.18±0.09	p=0.0012
	LI	0.84±0.15	0.86±0.04	p=0.478(NS)	1.20±0.23	1.21±0.12	p=0.833(NS)
	CN	0.76±0.08	0.91±0.06	p<0.001	1.35±0.29	1.26±0.12	p=0.116(NS)

Max.- Maxillary arch
Mand.- Mandibular arch

CI-Central Incisor
LI-Lateral Incisor
CN-Canine

that gives rise to the assumption that numerous gingival biotypes might exist in any adult population[2]. It has been long known that the clinical appearance of healthy gingiva differs from subject to subject and even among different tooth types. Many features are genetically determined; others seem to be influenced by tooth size, shape and position and biological phenomena such as gender, growth and age. Historically, few authors have discussed the importance of 'thick versus thin' gingiva in restorative treatment planning and their different pathological responses when subjected to inflammatory, traumatic, or surgical insults. Thick gingival tissue is probably the representation most associated with periodontal health in which the tissue is dense in appearance with a fairly large zone of attachment and relatively thick underlying osseous forms. The gingival topography is relatively flat with the suggestion of a thick underlying bony architecture. Thin gingival tissue tends to be delicate, friable and almost translucent in appearance with a minimal zone of attached gingiva. The osseous architecture associated with this gingival tissue type is characterized by fenestration and dehiscence[9].

Various studies have concluded that GTH plays a vital role in development of mucogingival problems, in the success of treatment for recession[10], flap management during regenerative surgical procedures[4,8] and also a significant predictor of the clinical outcome of root coverage procedures[10]. If gingival tissues are different for thick and thin tissue biotypes, it seems logical that these distinctions would significantly influence periodontal therapy, orthodontic tooth movement and implant site preparation[9] hence the assessment of GTH is gaining a large momentum.

Studies comparing invasive and non-invasive methods of assessing gingival thickness are scanty. Hence in the present study an attempt has been made to assess and compare the two methods of assessing GTH i.e. TGP and USG in association with site, age, gender, tooth and dental arch wise in Indian population.

This study sought to answer a few key questions:

(1) Can a non-invasive diagnostic method be developed using ultrasound, and

(2) Will this method be significantly more accurate than existing methods?

In this study USG measurements were done using a B-scan probe and the placement of straight ultrasonic probe tip was convenient in the anterior segment and the close adaptation of probe delivers ultrasonic waves at right angle to the tissues to be measured in the facial gingiva of anterior teeth. The frequency of B-scan was 10MHz. In a study conducted by Savitha B et al (2005)[1], the authors used a A-scan probe with the frequency of 10MHz, higher than SDM device used by Muller (2000) (5MHz)[11]. Eger et al (1996)[12] measured the thickness of attached gingiva using a commercially

available A-mode, intraoral ultrasonic device and reported that the validity and reliability of measuring gingival thickness with the ultrasonic device was found to be excellent. They also assessed the GTH in half mandibles of freshly slaughtered 6 month old pigs using an endodontic reamer for transgingival probing followed by an ultrasonic device, and reported an excellent validity of the result of the ultrasonic device.

A study was conducted by Tsiolis FI et al (2003)[13] to investigate high-frequency ultrasound imaging for periodontal assessment using a newly developed ultrasonic scanner with a frequency of 20 MHz in pig jaws. Three teeth per jaw were imaged with the scanner and duplicate measurements were made of the distance from a fixed landmark on the teeth to the alveolar bone crest. These measurements were compared to transgingival probing and direct measurements of the same teeth following reflection of the soft tissues and concluded that the ultrasound measurements showed better repeatability than either of the other two methods. Also, ultrasound was in better agreement with direct, open probing measurements than transgingival probing with direct measurements.

In the present study both TGP and USG measurements were reliable in measuring GTH midbuccally and interdental papillary region unlike the study conducted in thirty two periodontally healthy subjects by Savitha B et al (2005)[1], in which authors concluded that USG measurements were not dependable in papillary region.

Analysis of GTH at both sites, i.e. midbuccal and interdental papilla, indicated that the gingiva was thicker in the younger age group than the older age group. Similar results were found in the study conducted by Savitha B et al (2005)[1], in which the authors concluded that the thicker gingiva in the younger age group than the older age group might be because of changes in the oral epithelium caused by age, related to thinning of the epithelium and diminished keratinization. There may be other confounding factors such as racial and genetic factors that need to be investigated further.

Gender wise comparison showed that the female subjects had thinner gingiva than males at the midbuccal region. At interdental papillary region, female subjects had significantly thicker gingiva than males when assessed by both the methods. The results of the present study were different from the studies of Savitha B et al (2005)[1] and Muller (2000)[11] in which the GTH has been reported to be thinner in female subjects than male subjects at both the sites.

Tooth wise comparison of GTH between the two methods showed that GTH varied between the central incisor, lateral incisor and canine. The difference between the two methods was found to be significant both at the midbuccal and interdental papillary region, but the differences were insignificant at mandibular central incisor and lateral incisor at the midbuccal site. At the interdental papillary region, the differences were insignificant at mandibular lateral incisor and canine. As observed in the present study thickness of gingiva varied with the teeth i.e. central incisor, lateral incisor and canine indicating that thickness of gingiva is dependent on the type of teeth. Muller (2000)[11] confirmed in a study that the thickness of the gingiva varies with the morphology of the crown. However in the present study it was observed that the thickness of gingiva was greater in the central incisor at midbuccal site followed by lateral incisor and canine in both the dental arches as measured by TGP method but when measured by USG method the thickness of gingiva was greater in the canine followed by central incisor and lateral incisor at midbuccal site in maxillary arch. In mandibular arch the sequence found in decreasing order was canine followed by lateral incisor and central incisor when measured by USG method. At interdental papillary region, the thickness of gingiva was greater in the canine followed by lateral incisor and central incisor by both the methods. The results of the present study were inconsistent with the results of the study done by Savitha B et al (2005)[1] in which the GTH was greater in the canine by TGP method.

On comparing the GTH dental arch wise by both the methods, maxillary arch showed a thicker gingiva at midbuccal site as compared to the mandibular arch whereas at interdental papillary region, maxillary arch showed a thinner gingiva as compared to the mandibular arch. This is in contrast to the results of Savitha B et al (2005)[1], who found the gingiva to be thinner in the maxilla

than in the mandible at both the sites as assessed by TGP method.

The present study was a pioneer study as:

1. Extra-oral ultrasonic transducer probe was used for the first time for the assessment of GTH and
2. Comparison between TGP and USG methods in association with age, gender and dental arch was done for the first time.

Limitations of the study:

The study could have recruited more subjects which can enhance the validity of the study. Because of this limitation, the present results should be viewed as preliminary. However, more research is needed to validate these claims.

CONCLUSION

The need of the hour is to carry out the dental investigatory procedures atraumatically, rapidly, and rather inexpensively. In the present study, the authors attempted to address this need of the hour by comparing the two methods for the assessment of gingival tissue thickness with transgingival probing and ultrasonography methods. The authors concluded that ultrasonography method might be a step towards continuing to learn and improve the care we offer to our patients as the thickness of gingival tissue is assessed more accurately, rapidly and atraumatically as compared to transgingival probing method. Every tiny bit of tissue is precious and with these recent measures like ultrasonography technique we can attempt to preserve them even better.

Considering the success of ultrasound imaging in medicine, the use of ultrasound technology in dentistry seems especially promising. From a practical point of view, the device can expand our diagnostic scope like in periodontal treatments, in oral implant and plastic surgery, and during orthodontic therapy. As ultrasound technology advances, researchers remain hopeful that ongoing studies will provide the information necessary to further develop existing applications.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Savitha B, Vandana KL. Comparative assessment of gingival thickness using transgingival probing and ultrasonographic method. Indian Journal of Dental Research 2005;16(4):135-9.
2. Hans-Peter Muller, Nils Schaller and Thomas Eger. Ultrasonic determination of thickness of masticatory mucosa: A methodologic study. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology 1999;88(2):248-53.
3. DG Foushee, JD Moriarty and DM Simpson, Effects of mandibular orthognathic treatment on mucogingival tissues. J Periodontol 1985;56:727–33.
4. Anderigg CK, Hetzler DG, Nicole BK. Gingival thickness in guided tissue regeneration and associated recession at facial furcation defects. J Periodontol 1995;66:397-402.
5. Claffey Shanley. Relationship of gingival thickness and bleeding to loss of probing attachment in shallow sites following non-surgical periodontal therapy. J Clin Periodontol 1986;13:654-7.
6. Ostlund SG. The effect of complete dentures on the gum tissues: A histological and histopathological investigation. Acta Odontol Scand 1958;16:1-40.
7. Lytle RB. The management of abused oral tissues in complete denture construction. J Prosthet Dent 1957;7:27-42.
8. Goaslind GP, Robertson PB, Mohan CJ, Morrison WW Olsson JV. Thickness of facial gingiva. J Periodonta1 1974;48:768-71.
9. Richard T. Kao, Mark C. Fagan and Gregory J. Conte. Thick vs. Thin Gingival Biotypes: A Key Determinant in Treatment Planning for Dental Implants. CDA Journal 2005;136(3):193-8.

10. Carlo B. Coronally advanced flap procedure for root coverage. Is flap thickness a relevant predictor to achieve root coverage-A-19 case series. J Periodontol 1999;70:1077-84.

11. Muller HP. Masticatory mucosa in subject with different periodontal phenotypes. J Clin Periodontol 2000;27:621-6.

12. Eger T, Muller HP, Heinecke A. Ultrasonic determination of gingival thickness, subject variation and influence of tooth type and clinical features. J Clin Periodontol 1996;23:839-45.

13. Tsiolis FI, Needleman IG, Griffiths GS. Periodontal ultrasonography. J Clin Periodontol. 2003;30(10):849-54.