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Ultrasonography and lateral cephalometrics in the measurement of gingival thickness –A non-invasive way to go

AUTHOR DETAILS:

1. **Dr Pragya Sharma**
   Senior Lecturer, Department of Periodontology, Shree Bankey Bihari Dental College and Research Centre, Masuri, Ghaziabad (U.P) Email: pragyasw9@gmail.com
2. **Dr Kuldip Sangha**
   Assistant Professor, Department of Periodontics, Government Dental College, Raipur, Chhattisgarh, Email: dentico29@gmail.com
3. **Dr Rajkishen Agrawal**
   Assistant professor, Dept. of Periodontics, Yogita dental college and hospital, Khed Email: rajkishen.agarwal03@gmail.com
4. **Dr Neelam Gavali**
   Assistant Professor, Bharati Vidyapeeth (Deemed to be) University Dental College& Hospital, Pune. Email: drneelamkakde@gmail.com
5. **Dr. Rachita Mustilwar**
   Lecturer, Department of Periodontology, Rural Dental College, Pravara Institute of Medical Sciences, Loni (Bk)
6. **Dr Hiroj Bagde**
   Associate Professor, Department of Periodontology, New Horizon Dental College and Research Institute, Bilaspur, Chhattisgarh. Email: hirojbagde8@gmail.com

Corresponding Author
Dr Hiroj Bagde

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Associate Professor, Department of Periodontology, New Horizon Dental College and Research Institute, Bilaspur, Chhattisgarh. Email: hirojbagde8@gmail.com

ABSTRACT

BACKGROUND:Gingival morphology plays an important role in esthetics of a patient. A direct correlation exists between gingival biotype and susceptibility to gingival recession following surgical or restorative procedure.

AIM: To evaluate and compare the accuracy and efficacy of two non invasive methods such as ultrasonography (USG) and lateral cephalometric analysis with transgingival probing in determining the gingival thickness.

MATERIALS & METHODS: 30 subjects with healthy periodontium, no loss of attachment and presence of all anterior teeth in both upper and lower jaw were selected for this study. Gingival thickness was evaluated using three techniques: transgingival probing, ultrasonography and lateral cephalometrics.Transgingival probing recorded with a UNC-15 probe was used as gold standard for all comparative evaluations.Ultrasonographic measurements were carried out using B-scan with transducer probe. Lateral cephalometric analysis was done by placing tin foil over the gingiva.

RESULTS: Ultrasonographic measurements gave accurate results when compared with transgingival probing. Lateral cephalometric measurements overestimated values for gingival thickness.

CONCLUSION: Ultrasonography can be a valuable non invasive technique for the measurement of gingival thickness.

INTRODUCTION

In recent years, the dimensions of different parts of the masticatory mucosa, especially gingival thickness, has become the subject of considerable interest in periodontics from both an epidemiologic and a therapeutic point of view. Several studies have concluded that the thickness of the gingiva plays a vital role in development of mucogingival problems and can affect the results of periodontal therapy, root coverage procedures, implant placement and wound healing.[1,2,3,4]

Mucogingival problems may result from orthodontic movement of teeth away from the alveolar process, particularly among patients with thin periodontium. The level of gingival thickness before regenerative surgery was found to be a predicting factor for further recession. Kois et al proposed that postsurgery clinical results were strongly associated with the gingival and alveolar crest form.[5] In cases with low alveolar crest position, an increased susceptibility for gingival recession may expose restorative margins when finish lines are placed intracrevicularly. Patients with thick gingiva appear less likely to experience gingival recession after surgical or restorative therapy. Differences in gingival and osseous architecture have a significant impact on the outcome of treatments. This makes it necessary for the clinician to recognize and identify gingival biotypes inorder to achieve optimal treatment outcomes.

In 1969, Ochsenbein & Ross indicated that there were 2 main types of gingival anatomy—*flat* and *highly scalloped.* The authors reported that flat gingiva was associated with a square tooth form, while scalloped gingiva was associated with a tapered tooth form. The authors also proposed that the gingival contour closely

mimics the contour of the underlying alveolar bone.[5] Later Siebert and Lindhe categorized the gingiva into ‘‘thick - flat’’ and ‘‘thin – scalloped’’ biotypes. A gingival thickness of ≥2 mm (measurements of 1.6–1.9 mm were not accounted for) was considered as thick tissue biotype and a gingival thickness of <1.5 mm was referred as thin tissue biotype.[6] In a study by De Rouck et al, the thin gingival biotype occurred in one-third of the study population and was most prominent among women, while the thick gingival biotype occurred in two-thirds of the study population and occurred mainly among men.[5]

Till date, different techniques have been proposed to measure gingival thickness. These include direct method (transgingival probing)[7], ultrasonography[8,9], cephalometric analysis[10] , Cone beam computed tomography (CBCT) scans [11, 12].Each technique individually has its own significance, advantages and drawbacks. Studies comparing invasive and noninvasive methods of assessing gingival thickness are scanty. Hence this study was designed to determine the validity,reliability, and accuracy of transgingival probing, ultrasonography, and lateral cephalometrics in determination of gingival thickness.

Materials and methods

30 subjects with healthy periodontal tissues with no loss of attachment and presence of all anterior teeth in both upper and lower jaw were selected from those visiting out patient department of Department of periodontics and oral implantology of New Horizon dental college and research institute Sakri- Bilaspur.

Subjects with crowns with Subgingival margins,, restorations and fillings involving the maxillary anterior teeth,pregnant and lactating females, subjects taking medication with any known effect on the periodontal soft tissues and subjects with clinical signs of periodontal disease defined as having pockets greater than 3 mm were excluded from the study.

The study protocol was duly reviewed and approved from the institutional ethical committee.Informed consent was obtained from the eligible subjects after explaining about the study.

The assessment of the gingival thickness in all the selected subjects was carried out by the three methods as under:

A. Direct method (Trans gingival probing**):**

The gingival thickness was assessed by anaesthetizing the facial gingiva , infiltration was done using 2% lignocaine HCl with 1:80,000 adrenalin injection. A UNC15 probe was used to assess

the measurement points 20 minutes after injection. The gingival thickness was assessed midbuccally in the attached gingiva, half way between mucogingival junction and free gingival groove and at the base of the interdental papilla tooth wise i.e. at central incisor, lateral incisor and canine . Measurements were then rounded upto the nearest millimeter

B. Ultrasonic Method:

The Ultasound machine Suoer SW -2000® A Scan (ophthalmic ultrasound device) with a frequency of 10 MHz with LED, depth of 40mm , a precision of ±0.05 mm including a digital display, scan display, a transducer probe, built in printer and foot switch was used for the ultrasonic recordings. The transducer probe was adapted to the gingival surface coinciding with the bleeding point created during transgingival probing. The mechanism of action of ultrasound based on the transit time for the pulse (ultrasound wave)to travel to the bone (hard tissue) and echoed back creates spikes on the monitor immediately. Utilizing the print out of this graph and with the help of the optical projector, the thickness of gingiva was determined.

C.Lateral cephalometric assessment

To highlight the soft tissue structures on the radiograph, an innovative radiographic technique[13] using the auxiliary element of lead foil was used .The lead foil was selected on account of its opaque nature. The thickness of the lead foil was recorded and then it was cut appropriately and then positioned over the gingival surface, aligned with the long axis of the teeth . The anterior maxillary sextant from the left maxillary canine till the right maxillary canine was included. This would serve to delimit the profile of the gingiva from the lateral perspective. Lateral cephalometric radiographs were obtained using the Orthophos-XG® digital panoramic and cephalometric System (Sirona Dental, Germany) Each subject's head was stabilized by positioning the ear-rods of the cephalostat machine in the external auditory meatus with the Frankfort plane parallel to the horizon and sagittal plane at right angle to the path of the x-ray and the teeth in centric occlusion with the lips in a closed and relaxed position. The cephalogram images were then imported into the Sirona software bundled with the above mentioned device.This software allows the operator to draw straight lines between two points, and the program measures the distance between those points with a precision of 0.1 mm . The gingival

thickness was visualized as a radiopaque area having a radiodensity less than the alveolar process. Its thickness was calculated by drawing two lines; one from the exterior most less radiopaque border and the other from the more radioopaque alveolar process. The area between these lines was calculated and the lead foil thickness was substracted from this measurement to obtain the final gingival thickness.

Data obtained was analyzed using the SPSS 16 software.

Results

This study included 30 patients of both sexes with 16 male and 14 female subjects ranging in age between 16-38 years who satisfied the selection criteria. A total of 270 sites were assessed in the anterior segment of the mouth at baseline.

EFFICACY

ANOVA-The means and standard deviations from this analysis are shown in TABLE I.All measurement were significant.

Post hoc tests-It was conducted to compare the measured gingival thickness from GROUP I (transgingival probing) which is a gold standard with GROUP II (ultrasonography) and GROUP III (lateral cephalometrics) respectively as shown in TABLE II.

There is no significant difference between gingival biotype measurements in GROUP I and GROUP II (P=0.234).But there is a highly significant difference between GROUP I and GROUP III (P=0.00)

TABLE I-ANOVA measurement

	Sum of Squares	Mean square	Sig.
Between the group	7.161	3.581	.001
Within the groups	38.876	.477	
Total	46.037		

TABLE II

Post HOC tests

Multiple comparison dependent variable measurement

LSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	**2**	-.21	.173	.234	-.55	.14
	3	-.67(*)	.173	.000	-1.02	-.33
2	**1**	.21	.173	.234	-.14	.55
	3	-.47(*)	.173	.008	-.81	-.12
3	**1**	.67(*)	.173	.000	.33	1.02
	2	.47(*)	.173	.008	.12	.81

* The mean difference is significant at the .05 level.

DISCUSSION-

Gingival tissue biotype is a significant factor that influences the esthetic treatment outcomes. The effect of gingival biotype on recession and root coverage procedures has been extensively studied.

Studies comparing invasive and noninvasive methods of assessing gingival thickness are scanty. Hence in the presence study an attempt was made to compare the two methods i.e. transgingival probing (TGP) and ultrasonographic method (USG). In this study USG measurements were done using an 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 the A scan was l0MHz, higher than SDM device used by Muller[11] (5MHz), which provided better tissue penetration of the ultrasound waves.

Gingival thickness was assessed by an invasive method using a disposable sterile needle[12], stainless steel wire[13] and bone sounding with a periodontal probe[10], while noninvasive methods included the use of A mode and B mode ultrasonic device.[14]

The mean gingival thickness noted in Bilaspur population was 2mm.Transgingival probing was used as a Gold standard in this study as it is the most conventionally used method however,measurement were overestimated in the range of 0.5-1mm than the Ultrasonography due to crude way of measuring the thickness using periodontal probe with 1mm marking and rounding the measurement to next mm marking. Ultrasonography measurement showed discripency at interdental papilla region due to difficulty in placement of probe,leading to scattering of ultrasound waves and absorption of waves by soft tissue without being rebounded back.Lateral cephalometrics highly overestimated on account of magnification of image.

A decided attitude of expectation among many patients has given a new perspective to regenerative[8] and plastic periodontal surgery.[7] With authors emphasizing on the importance of gingival thickness, attempts are being made to obtain necessary information atraurnatically, rapidly and with relatively low cost. The most important indication for measuring soft tissue thickness is clearly plastic periodontal surgery. However the selection of periodontal therapy on gingival thickness and further, the influence of gingival thickness on treatment outcome is still not clear.T he gingival morphology of the maxillary anterior region plays an important role in determining the final esthetic outcome.[15]

CONCLUSION

Transgingival probing and ultrasonography measurement are reliable in measuring gingival thickness midbuccally while ultrasonography measurement are not dependent in papillary region.USG technique stands to be noninvasive technique but is expensive and technique

sensitive.Lateral cephalometrics has limitation of overestimating result on account of magnification and has radiation hazards to the patient.So,Bilaspur population have a thick gingival biotype (according to Rouck et al 2009) and represent a population on whom good predictability of mucogingival surgeries can be done by periodontists.

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