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Association of Transgingival Probing with CBCT Evaluation for Determination of Biotype of the Gingiva

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Authors' contributions

This work was carried out in collaboration among all authors. Author MYA wrote original draft of the manuscript and did Literature searches. Author SA wrote original draft of the manuscript and performed study design. Author ZHC wrote and reviewed the manuscript. Author AH did literature searches and performed study design. Author FQ reviewed the manuscript. Author MA wrote original draft and did data analysis. Author KA did data analysis and reviewed the manuscript. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: The study aimed for determination of correlation between transgingival probing and CBCT evaluation, for the determination of gingival biotype.
Study Design: Cross-sectional study.
Place and Duration of Study: Department of Periodontics, Fatima Memorial Hospital, Lahore and 17th August 2016 to 16th February 2016.
Methodology: In this cross-sectional study, a total of 40 patients indicated to undergo implant placement for posterior maxillary teeth or any mandibular teeth, 18 to 50 years were included. Patients with the presence of restoration in the anterior maxilla, pregnant or lactating women, root

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canal treatment in the anterior maxilla, and h/o apical surgery were excluded. A single radiologist examined the CBCT obtained from all of the patients. Linear measurements for buccal wall & gingival biotype were measured.
Results: The mean age was 35.13 ± 7.75 years. Of the 40 subjects, there were 22 (55.0%) females and 18 (45.0%) males. On CBCT, the radiographic measures were 1.49 0.34 mm for the right central and 1.49 0.34 mm for the left central. There is a statistically significant link between transgingival probing and CBCT examination for determining gingival biotype, with a Spearman's correlation coefficient of 0.985 and a p-value of 0.0001.
Conclusion: According to the findings of this study, there is a substantial positive association between transgingival probing and CBCT measures of gingival biotypes.

Keywords: Gingival biotype; transgingival probing; cone beam computed tomography.

1. INTRODUCTION

The biotype of the gingiva is defined as the dimensions of the gingiva in the facial-palatal direction [1]. Commonly, it is categorized as thin scalloped, thick flat, and thick scalloped [2]. If the biotype of the gingiva is less than or equivalent to 1.5mm, than it is called as “thin” biotype of gingiva [3]. If the biotype of gingiva is greater than or equivalent to 2mm, than it is called as “thick” biotype of gingiva [3]. The dimensions of the gingiva for example width and thickness, show variations amongst the individuals, that show correlations with the type and shape of the teeth, with some association with genetics as well.

[4]. Recent evidence suggests that the phenotypes of the gingiva have been distinctly recognized on levels of the subject, with existence that has been concluded using cluster analysis based patients with healthy periodontium amongst young patients [5]. It has been observed that patients that have thin biotype of gingiva tend to suffer from greater gingival recession as compared to those with thicker gingiva biotype [5].

It has been known that gingival biotype is one of the factors of concern in terms of factors that can effect of prognosis of the teeth undergoing dental treatment. The biotype of gingiva has its effects on the outcomes associated with implant surgeries, periodontal treatment, and treatments involving coverage of the roots.

When the effect of inflammation, restorative and surgical treatment on different gingival biotypes is studied, differences have been noted, which mandates identification of the biotypes before commencement of treatments [6].

Different modalities are available that evaluate the gingival biotype with the help of invasive and non-methods for e.g., CBCT, transgingival probing, directly measuring the thickness, and ultrasound-guided techniques. A simple and objective method for determination of gingival biotype is by the use of periodontal probing. In a study by Goaslind and colleagues found two biotype of the gingiva such as thick and think by the use of digital voltmeter [7].

In a study by Becker and colleagues, scalloped, flat and pronounced scalloped gingiva were identified as three periodontal morphologies. The identified periodontal morphotype’s dimension from mid-facial height to interproximal bone height was: flat= 2.1 mm, scalloped= 2.8 mm, pronounced scalloped= 4.1 mm [8].

As per the authors, there was no study in the literature that evaluated the correlation between CBCT and transgingival probing. Therefore, this study aimed to assess the correlation between CBCT and transgingival probing. The biotype of gingiva is different between the Pakistani population and the Caucasian and Chinese population. Mean values formulated by the above-mentioned authors may not serve as references for the Pakistani population. Each population should be treated according to specific characteristics of its own. It is thus important to establish the gingival biotype in the local population to provide predictable restorative and surgical treatment results. The aim of this research was to assess correlation amongst transgingival probing and CBCT evaluation, for the determination of gingival biotype.

2. MATERIALS AND METHODS

2.1 Study Design and Sample Size

This observational study was commenced from 17th August 2016 to 16th February 2016 at the Department of Periodontics, Fatima Memorial Hospital, Lahore. Following the Declaration of Helsinki, this study was executed. For this study,

the subjects were enlisted using a non-probability, consecutive sampling method. The process of data collection was started after being granted ethical approval. For calculation of sample size, OpenEpi software was used. Using the following values: 5% type-I error, and 10% type-II error, and taking the expected correlation coefficient between clinical method (TP) and radiographic method (CBCT) for diagnosis of gingival biotype i.e., r=0.401, the sample size was calculated to be 61. Since practically it's not possible for us to collect the data of 61 implant cases in a 6-months duration so we had taken the sample of 40 cases.

2.2 Inclusion and Exclusion Criteria

The participants who were enlisted in this study had to obey the eligibility criteria that was pre-established. The participants were included as part of this research of the following conditions:

- Age 18 to 50 years.
- Periodontally healthy individuals.
- The patient indicated to undergo implant placement for posterior maxillary teeth or any mandibular teeth as dictated by his/her treatment plan.

The participants were excluded from this study on the basis of the following factors:

- History of chemotherapy and radiotherapy.
- History of diabetes, or any medications such as bisphosphonates, or drugs/conditions causing gingival enlargement.
- Pregnant or lactating mothers.
- Pathological migration of teeth, malalignment of teeth.
- Presence of soft tissue recession.
- Smokers.
- Presence of restoration in the anterior maxilla.
- Root canal treatment in the anterior maxilla.
- Any history of apical surgery.
- Any history of orthodontic treatment.

2.3 Data Collection

The participants who fulfilled the selection criteria from the dental outpatient department of Periodontics Fatima Memorial Hospital were selected. The approval was taken from the ethical review committee of Fatima memorial hospital. The consent form was signed by every patient. The demographic profile of all the patients was recorded, history of past dental condition was explored and detailed dental examination was done. One radiologist carried all CBCT scans from the SIRONA machine of all subjects. As per operational definitions, linear measurements for buccal wall & gingival biotype were measured. After administration of local anesthesia, the facial region of the gingiva was examined to obtain the gingival biotype using periodontal probe.

2.4 Statistical Analysis

After the collection of the data, it was analyzed using Statistical Packages for Social Sciences (SPSS) version 20.0. The mean and standard deviation for variables like age and measurements from radiographs obtained from CBCT were calculated. Frequency and percentages were calculated for gender, visual inspection of the clinical method, and on radiographic (i.e., ≥ 1.5mm). The assess the association between transgingival (clinical method) and CBCT (radiographic method) to diagnose the biotype of the gingiva, spearman's correlation test was used. A p-value of ≤ 0.05 was considered to be as statistically significant. With stratification, the effect modifiers such as age and gender were administered. Post-stratification Spearman's correlation coefficient was calculated to see the effect of these on the outcome and a p-value of ≤ 0.05 was considered to be as statistically significant.

3. RESULTS

The participants in this research ranged in age from 18 to 50 years old, with a mean age of 35.13 7.75 years. The bulk of the 28 patients (70.0%) were between the ages of 18 and 40 as shown in Table 1.

Table 1. Age distribution for both groups (n=40)

Age (years)	Patients	Percentage
18-30	14	35.0
31-40	14	35.0
41-50	12	30.0

There were 22 (55.0%) females and 18 (45.0%) men among the 40 patients, for a female to male ratio of 1.2:1 (Fig. 1).

On CBCT, radiographic measures were 1.49 0.34 mm for the right central and 1.49 0.34 mm for the left central (Table 2). Gingival biotype for right central and left central on visual inspection on clinical method and on radiographic are shown in Table 3 & 4 respectively.

The correlation between transgingival probing and CBCT evaluation, for the determination of gingival biotype, is shown in Table 5 with Spearman's correlation coefficient of 0.985 and p-value = 0.0001 which is statistically significant.

Table 6 shows age stratification and Spearman's correlation coefficient to establish the link between clinical technique (Transgingival Probing) and radiographic method (CBCT) for gingival biotype identification. Gender stratification and Spearman's correlation coefficient were used to assess the association between the clinical method (Transgingival Probing) and the radiographic method (CBCT) for determining gingival biotype is shown in Fig. 2.

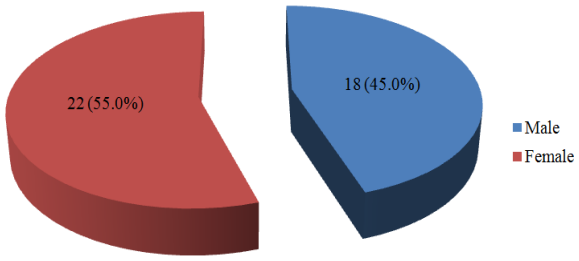

Fig. 1. Distribution of patients according to gender

Table 2. Radiographic measurements on CBCT (n=40)

	Minimum	Maximum	Mean	SD
CBCT (Right Central)	0.97	2.13	1.49	0.34
CBCT (Left Central)	0.98	2.10	1.49	0.32

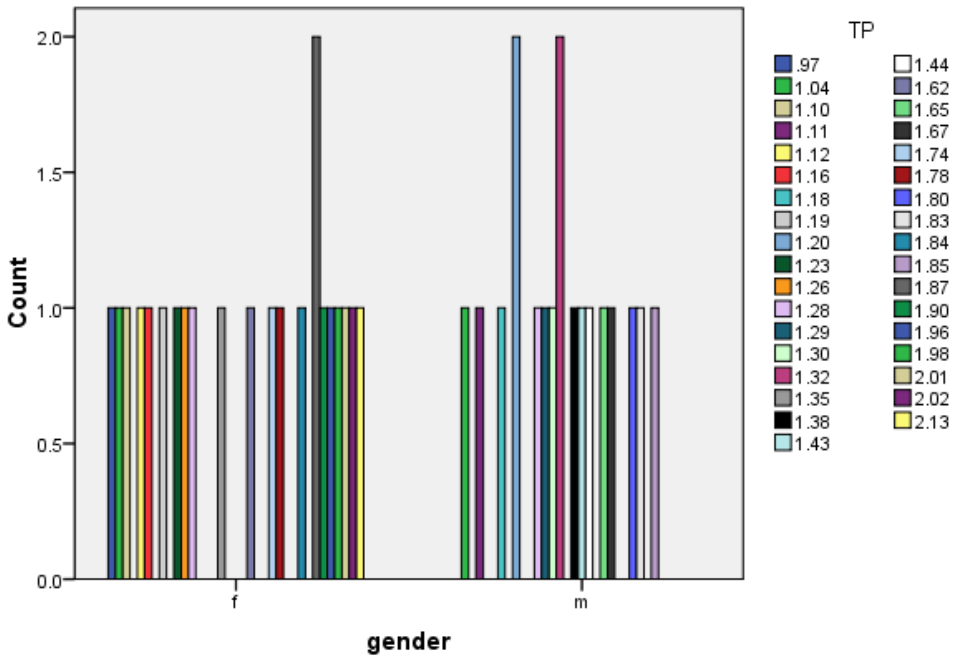

Fig. 2. Stratification of gender and Spearman's correlation coefficient to determine the relationship between clinical method (transgingival probing) and radiographic method (CBCT) for the diagnosis of gingival biotype

Table 3. Gingival biotype for right central on visual inspection on clinical method and on radiographic (n=40)

	Thin	Thick
Gingival biotype on visual inspection	19 (47.50%)	21 (52.50%)
Gingival biotype on visual inspection on radiographic	23 (57.50%)	17 (42.50%)

Table 4. Gingival biotype for left central on visual inspection on clinical method and on radiographic (n=40)

	Thin	Thick
Gingival biotype on visual inspection	19 (47.50%)	21 (52.50%)
Gingival biotype on visual inspection on radiographic	23 (57.50%)	17 (42.50%)

Table 5. Spearman's correlation coefficient was calculated to determine the relationship between clinical method (transgingival probing) and radiographic method (CBCT) for the diagnosis of gingival biotype

Correlations				
			TP	**CBCT**
Spearman's rho	Transgingival Probing	Correlation Coefficient	1.000	0.985**
		Sig. (1-tailed)	.	0.000
		N	40	40
	CBCT	Correlation Coefficient	0.985**	1.000
		Sig. (1-tailed)	0.000	.
		N	40	40

***. Correlation is significant at the 0.01 level (1-tailed)*

Table 6. Stratification of age and Spearman's correlation coefficient to determine the relationship between clinical method (transgingival probing) and radiographic method (CBCT) for the diagnosis of gingival biotype

Correlations					
			Age	TP	CBCT
Spearman's rho	Age	Correlation Coefficient	1.000	.077	.073
		Sig. (1-tailed)	.	0.319	0.327
		N	40	40	40
	TP	Correlation Coefficient	0.077	1.000	0.985**
		Sig. (1-tailed)	0.319	.	0.000
		N	40	40	40
	CBCT	Correlation Coefficient	0.073	0.985**	1.000
		Sig. (1-tailed)	0.327	0.000	.
		N	40	40	40

***. Correlation is significant at the 0.01 level (1-tailed)*

4. DISCUSSION

"Gingival biotype can be determined by direct visual examination, periodontal probing, or direct measurements using endodontic spreaders, endodontic files, and calipers. Only the buccopalatal assessment of gingival thickness is worth examining for clinical and research reasons if the adjectives "thick" and "thin" are focused on. To quantify tissue thickness, many invasive and non-invasive approaches were developed. Direct measurement, probe transparency (TRAN) technique, ultrasonic devices, and cone-beam computed tomography (CBCT) scan are among them". [9,10,11].

"The use of ultrasonic transducers to assess thickness is a non-invasive technology that has been proven to be repeatable" [12],131 however, downsides include challenges in maintaining transducer directionality [13], device unavailability [14], and expensive prices. "These considerations may be to blame for the gadget not being part of the clinician's conventional armamentarium. A simplified approach for distinguishing thin from thick gingiva based on the transparency of the periodontal probe through the gingival edge has been presented" [15].

"Cone-beam computed tomography (CBCT) has recently been employed as an enhanced diagnostic tool in assessing the thickness of both hard and soft tissues" [11]. "According to Fu et al., CBCT gives precise measures of bone and labial soft tissue thickness. He concluded that CBCT measurements may be a more objective approach than direct measurements for defining

the thickness of both soft and hard tissues" [16]. Only a few research have reported the thickness of facial gingiva using soft tissue CBCT, despite numerous studies previously examining the thickness of palatal mucosa using transgingival probing. Using transgingival probing and soft tissue CBCT, the current study sought to determine the relationship between the thickness of the mandibular anterior soft tissues and the underlying bone.

In my study, the age range was 18 to 50 years, with a mean age of 35.13 7.75 years. The bulk of the 28 patients (70.0%) were between the ages of 18 and 40. There were 22 (55.0%) females and 18 (45.0%) men among the 40 patients, for a female to male ratio of 1.2:1. There is a statistically significant link between transgingival probing and CBCT examination for determining gingival biotype, with a Spearman's correlation coefficient of 0.985 and a p-value of 0.0001. With an R-value of 0.401.10, Beijing Da Bao et colleagues discovered a substantial positive association between transgingival probing and CBCT assessments of gingival biotypes.

There is currently no specific definition of how a thick biotype differs from a thin one. One of the reasons is that the thickness of the gingiva has been measured at various vertical elevations. "Previously, intrusive procedures were utilised to estimate gingival thickness; direct measurement was used but had several disadvantages, including invasive approach, lack of repeatability, accuracy, incorrect angulation, and pressure" [17]. "To circumvent these constraints, non-invasive approaches such as ultrasonic devices" [18] and cone-beam computed tomography [19] were developed; however, these procedures are technique dependent and highly expensive. "The accuracy of manual evaluation using a calliper after tooth extraction , a syringe with an endodontic depth marker, or cone beam radiography without reference objects is limited" [20]. The most recent technique developed is a modified radiographic technique [21] described by Alpiste-Illueca [22], who discovered that "various morphometric parameters such as crown width/crown length ratio and gingival width could serve as surrogate parameters to predict gingival thickness at the cementoenamel junction".

Kan et al. [20] provided "a simple technique of determining periodontal type that relies on the translucency of free gingiva during probing of gingival grooves in teeth. The most often used approach for distinguishing thin and thick biotypes is visual assessment of the transparency of the periodontal probe through the sulcus. If the contour of the probe can be seen through the gingival edge from the sulcus, the gingival biotype is thin. The capacity of gingival tissue to hide the colour of any underlying material is required for attaining attractive outcomes, particularly in implant and restorative dentistry; for this purpose, subgingival metals are extensively utilised" . "The simplest technique to establish the thin gingival biotype is to use a metal periodontal probe in the sulcus to test gingival tissue thickness; the tip of the probe is visible through the gingiva . Periodontal probing methods are regularly used during periodontal and implant treatments because they are less invasive" [23].

"Both hard and soft tissues are seen and measured with CBCT. Several authors observed that CBCT measures of both bone and labial soft tissue thickness are reliable, and they concluded that CBCT measurements may be a more objective means of determining soft and hard tissue thickness than direct measurements. The CBCT approach, as opposed to transgingival probing and the ultrasonic device, offers a picture of the tooth, gingiva, and other periodontal tissues. Furthermore, measurements may be conducted several times with the same image acquired by ST-CBCT (soft tissue CBCT), which is not possible with other techniques" [24].

Stein et al [25] conducted "a comparative analysis of 60 people and discovered a link between buccal bone thickness and gingival thickness. However, the comparison in their study was not done at the same level. Instead, gingival thickness was assessed supracrestally, whereas bone thickness was measured behind the alveolar crest". In contrast, La Rocca et al [26] found "no significant link between the outcomes of CBCT scans and transgingival probing in an in vivo investigation of 90 maxillary teeth, despite the fact that the comparison in their study was not done at an equivalent level". Despite these conflicting results and the short sample size of our investigation, we discovered a significant positive correlation between transgingival probing and CBCT measurements of gingival biotypes.

5. CONCLUSION

According to the findings of this study, there is a substantial positive association between

transgingival probing and CBCT measures of gingival biotypes. In order to deliver anticipated restorative and surgical treatment outcomes, we suggest that CBCT be utilised to quantify both hard and soft tissue thickness as well as gingival biotype in every patient with periodontal disease.

CONSENT

All authors declare that 'written informed and verbal consent was obtained from the patients.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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