***Original Research Article***

# Correlation Between Transgingival Probing and CBCT Evaluation for Determination of Gingival Biotype


## ABSTRACT

**Aims:** This study aimed to determine the 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, from 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 canal treatment in the anterior maxilla, and h/o apical surgery were excluded. A single radiographer took all CBCT from the SIRONA machine of all subjects. Linear measurements for the buccal wall & gingival biotype were measured.

**Results:**The mean age was 35.13 ± 7.75 years. Out of the forty patients, 22 (55.0%) were females and 18 (45.0%) were males with a female-to-male ratio of 1.2:1. Radiographic measurements on CBCT were 1.49 ± 0.34 mm for right central and 1.49 ± 0.34 mm for left central. Correlation between transgingival probing and CBCT evaluation, for determination of gingival biotype with Spearman's correlation coefficient of 0.985 and p-value = 0.0001 which is statistically significant.

**Conclusion:**This studyconcluded that there is a significant positive correlation between transgingival probing and CBCT measurements of gingival biotypes.



*Keywords: Gingival Biotype, Transgingival Probing, Cone Beam Computed Tomography*


## 1. INTRODUCTION

Gingival biotype is the term used to describe the thickness of the gingiva in the facio-palatal dimension [1]. Commonly, it is categorized as thin scalloped, thick flat, and thick scalloped [2]. Gingival biotype is considered "thin" if it is equal to or lesser than 1.5 mm and it is considered "thick" if it is equal to or greater than 2 mm [3]. Gingival dimensions, like width and thickness, show great intra and inter-individual variations, which are associated with tooth type and shape, and are certainly also genetically determined [4]. Recently, distinct gingival phenotypes have been identified on a subject level, and their existence was later confirmed in an independent, periodontally healthy population of young adults by using cluster analysis [5]. Individuals with a thin phenotype had slightly more recession than subjects with wide and thick gingival tissues [5].

Among the factors that may affect the prognosis of dental treatments, gingival biotype is a critical cause of concern. It may affect the outcomes of periodontal therapy, root coverage

procedures, and implant placement. Different tissue biotypes respond differently to inflammation and surgical and restorative treatment; therefore, it is crucial to identify tissue biotypes before treatment planning [6].
Gingival thickness can be assessed by various invasive and non-invasive methods which include the direct method, transgingival probing method, ultrasound-guided methods, and, more recently, cone-beam computed tomography (CBCT). Periodontal probing-assessed gingival biotype is a simple, relatively objective, and suitable method for clinical examination. Goaslind et al. used a digital voltmeter and described 2 types of gingival biotypes commonly found in the natural dentition that is thick and thin [7].
Becker et.al proposed three different periodontal morphotypes: flat, scalloped, and pronounced scalloped gingiva. Measuring from the height of the bone interproximally to the height midfacially, findings were as follows: flat= 2.1 mm, scalloped= 2.8 mm, pronounced scalloped= 4.1 mm [8].
This study was being conducted to see a correlation between transgingival probing and CBCT as no local study was found in the literature search. The gingival biotype in the local Pakistani population is different from Caucasian and Chinese Asians. 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. This study aimed to determine the correlation between transgingival probing and CBCT evaluation, for the determination of gingival biotype.

## 2. MATERIAL AND METHODS

*2.1 Study design and Sample size*
This descriptive, cross-sectional study was carried out between 17$^{th}$ August 2016 to 16$^{th}$ February 2016. at the Department of Periodontics, Fatima Memorial Hospital, Lahore. Fatima Memorial Hospital is a tertiary care hospital affiliated with the University of Health Sciences. This study has been carried out following the Declaration of Helsinki. For this study, the participants were recruited using a non-probability, consecutive sampling method. The process of data collection was started after being granted ethical approval. For the calculation of sample size, OpenEpi software was used. The sample size of 61 cases was calculated with 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. 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 a sample of 40 cases.

*2.2 Inclusion and Exclusion Criteria*
Participation in this study was based on pre-determined inclusion and exclusion criteria. The participants were included in this study based on the following criteria:

- 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.
- No history of chemotherapy and radiotherapy.
- No history of diabetes, or any medications such as bisphosphonates, or drugs/conditions causing gingival enlargement.

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

- 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. Approval from the institutional review board (IRB) of Fatima memorial hospital was taken. A consent form was signed by every patient. The demographic profile of all the patients was recorded, the history of past dental condition was explored and a thorough dental checkup was carried out. A single radiographer took all CBCT from the SIRONA machine of all subjects. As per operational definitions, linear measurements for the buccal wall & gingival biotype were measured. All the information was recorded in a specifically designed Performa (Annexure-II)

*2.4 Statistical Analysis*

After the collection of the data, it was analyzed using SPSS version 20. Quantitative variables like age and radiographic measurements on CBCT were presented in the form of mean and standard deviation. Qualitative data like gender, visual inspection of the clinical method, and radiograph (i.e., ≥ 1.5mm) were presented in the form of frequency and percentages. Spearman's correlation coefficient was calculated to determine the relationship between the clinical method (Transgingival Probing) and radiographic method (CBCT) for the diagnosis of gingival biotype. P-value ≤ 0.05 was considered significant. Effect modifiers like age and gender were controlled by stratification. Post-stratification Spearman's correlation coefficient was calculated to see the effect of these on the outcome and a p-value ≤0.05 was taken as significant.

## 3. RESULTS

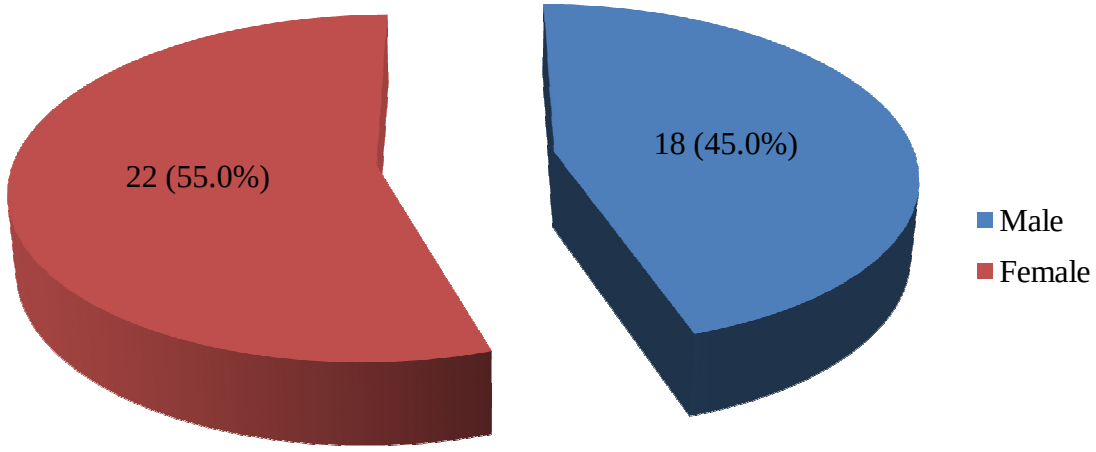
The age range in this study was from 18 to 50 years with a mean age of 35.13 ± 7.75 years. The majority of the patients 28 (70.0%) were between 18 to 40 years of age as shown in Table II

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

| Age (in years) | No. of Patients | Percentage |
|---|---|---|
| **18-30** | 14 | 35.0 |
| **31-40** | 14 | 35.0 |
| **41-50** | 12 | 30.0 |

Out of 40 patients, 22 (55.0%) were females and 18 (45.0%) were males with a female to male ratio of 1.2:1 (Figure 1).

**Figure 1: Distribution of patients according to gender**




Radiographic measurements on CBCT were 1.49 ± 0.34 mm for right central and 1.49 ± 0.34 mm for 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.

**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 |

**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%) |

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 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).

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 is shown in Table 6. 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 is shown in Figure 2.

**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**

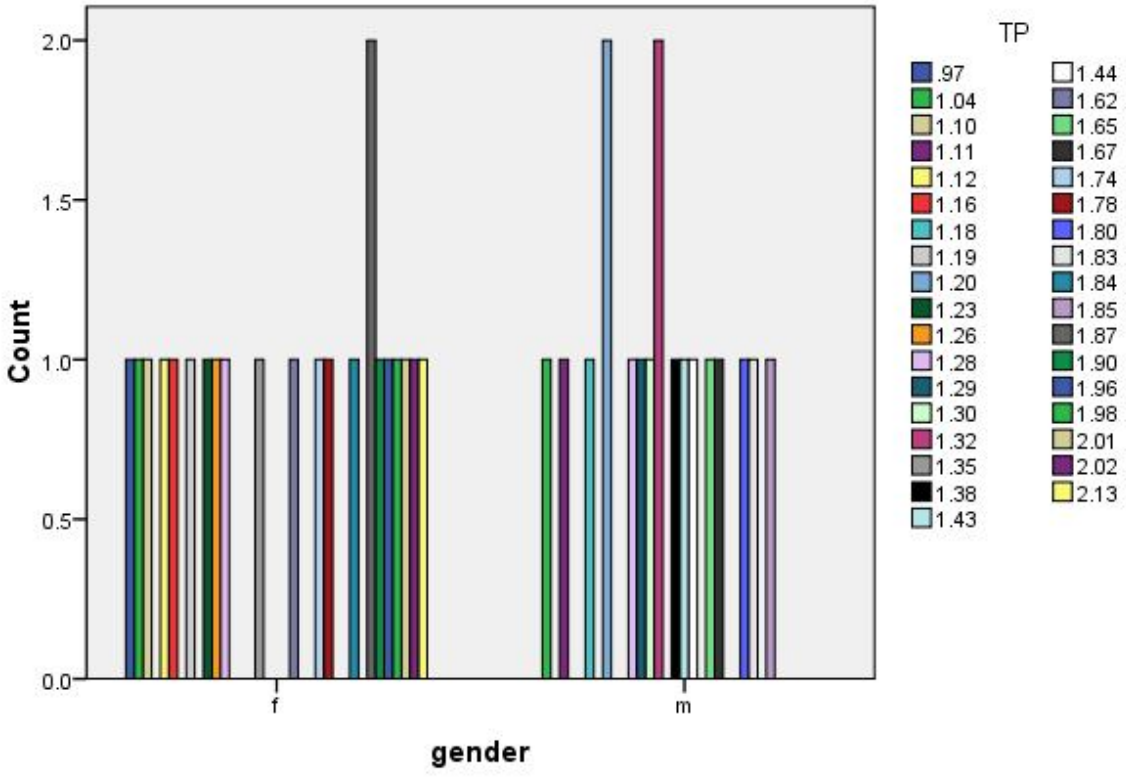
**Correlations**

| | | | 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).

**Figure 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**




## 4. DISCUSSION

Gingival biotypes can be evaluated either by direct visual assessment, by using a periodontal probe, or by direct measurements using endodontic spreaders, endodontic files, and calipers. If the terms “thick” and “thin” are focused upon, only the buccopalatal measurement of gingival thickness is worth evaluating for clinical and research purposes. Various invasive and non-invasive methods were proposed to measure tissue thickness. These include direct measurement, probe transparency (TRAN) method, ultrasonic devices, and cone-beam computed tomography (CBCT) scan [9][10][11].

The use of ultrasonic devices to determine thickness is a non-invasive method that has been proven to be reproducible [12],[131] drawbacks include difficulties in maintaining the directionality of the transducer [13]andunavailability of the device [14]and high costs. These factors may be responsible for the fact that the device has not become part of the standard armamentarium of the clinician. A simpler method has been proposed to discriminate thin from thick gingiva based on the transparency of the periodontal probe through the gingival margin [15].

Recently cone-beam computed tomography scan (CBCT) is being used as an advanced diagnostic aid in measuring the thickness of hard as well as soft tissues [11]. Fu et al. stated that CBCT provides accurate measurements of both bone and labial soft tissue thickness. He concluded that CBCT measurements might be a more objective method to define the thickness of both soft and hard tissues than direct measurements [16].Although several studies have previously investigated the thickness of palatal mucosa by transgingival probing, only a few reported the thickness of facial gingiva using the soft tissue CBCT method, the present study was undertaken to evaluate the association between soft tissue thickness of mandibular anterior and underlying bone using transgingival probing and soft tissue CBCT.

The age range in my study was from 18 to 50 years with a mean age of 35.13 ± 7.75 years. The majority of the patients 28 (70.0%) were between 18 to 40 years of age. Out of 40 patients, 22 (55.0%) were females and 18 (45.0%) were males with a female-to-male ratio of 1.2:1.Correlation between transgingival probing and CBCT evaluation, for determination of gingival biotype with Spearman’s correlation coefficient of 0.985 and p-value = 0.0001 which is statistically significant. Beijing Da Bao et al observed a significant positive correlation between transgingival probing and CBCT measurements of gingival biotypes with an R-value of 0.401.10.

Until now, there is no precise definition of how a thick biotype can be compared to a thin one. One of the reasons may be seen in the fact that the thickness of the gingiva has been assessed at different vertical levels. Earlier, invasive methods were used to determine the gingival thickness; direct measurement [17] was used but had various limitations i.e., invasive approach, lack of reproducibility, accuracy, improper angulation, and pressure. To overcome these limitations, non-invasive methods were devised; ultrasonic devices [18] and cone-beam computed tomography [19] but these methods are technique sensitive and quite expensive. Manual assessment using a caliper after tooth extraction [20], a syringe with an endodontic depth marker, or cone beam radiographs without reference objects have limitations in their accuracy. The most recent technique devised is a modified radiographic technique [21] described by Alpiste-Illueca[22], which determined that different morphometric parameters such as crown width/crown length ratio and gingival width could represent surrogate parameters to anticipate the gingival thickness at the cementoenamel junction.

Kan et al. [20] presented a simple method of periodontal type determination, which utilizes translucency of the free gingiva during the probing of gingival grooves in teeth. Visual inspection of the transparency of the periodontal probe through the sulcus has become the

most frequently used method for the discrimination of thin and thick biotypes. The gingival biotype is considered thin if the outline of the probe is shown through the gingival margin from the sulcus. The gingival tissue's ability to cover any underlying material's color is necessary for achieving esthetic results, especially in cases of implant and restorative dentistry, for this purpose subgingival alloys are widely used. Using a metal periodontal probe in the sulcus to evaluate gingival tissue thickness is the simplest way to determine the thin gingival biotype, the tip of the probe is visible through the gingiva [23]. This method is minimally invasive, and periodontal probing procedures are performed routinely during periodontal and implant treatments.

CBCT is used to visualize and measure the thickness of both hard and soft tissues. Various authors reported that CBCT measurements of both bone and labial soft tissue thickness are accurate and concluded that CBCT measurements might be a more objective method to determine the thickness of both soft and hard tissues than direct measurements. In contrast to transgingival probing and the ultrasonic device, the CBCT method provides an image of the tooth, gingiva, and other periodontal structures. Moreover, measurements can be repeatedly taken at different times with the same image obtained by ST-CBCT (soft tissue CBCT) which is not feasible by other methods [24].

Stein et al [25] performed a comparative study of 60 subjects and reported a positive correlation between buccal bone thickness and gingival thickness. However, the comparison in their study was not carried out at an identical level. Instead, the gingival thickness was evaluated at the supracrestal level, while bone thickness was measured under the alveolar crest. In contrast, in an in vivo study of 90 maxillary teeth, La Rocca et al [26] observed no significant correlation between the results of CBCT scans and transgingival probing, although the comparison in their study was also not performed at an identical level.Considering these conflicting results, and despite the limited sample size of our study, we observed a significant positive correlation between transgingival probing and CBCT measurements of gingival biotypes.

## 4. CONCLUSION

This study concluded that there is a significant positive correlation between transgingival probing and CBCT measurements of gingival biotypes. So, we recommend that CBCT is a beneficial method for measuring both hard and soft tissue thickness and gingival biotype should be established in every periodontal disease patient in order to provide predictable restorative and surgical treatment results.

## CONSENT (WHEREEVER APPLICABLE)

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

## ETHICAL APPROVAL (WHEREEVER APPLICABLE)

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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