

Gingival Thickness Assessment: Visual versus Direct Measurement

R. Shariatmadar Ahmadi¹, R. Tavassoli², F. Sayar¹, K. Ghaffari², F. Sarlati³✉.

¹ Assistant Professor, Department of Periodontics, Dental Branch, Islamic Azad University, Tehran, Iran

² Dentist, Private Office, Tehran, Iran

³ Associate Professor, Department of Periodontics, Dental Branch, Islamic Azad University, Tehran, Iran

Abstract

Background and Aim: Several methods have been suggested to measure gingival thickness. This study aimed to assess the reliability of visual assessment of facial gingival biotype of maxillary and mandibular teeth with or without using a periodontal probe in comparison with direct measurement.

Materials and Methods: Sixty-seven healthy patients (25 women and 42 men) with a total of 100 hopeless teeth were selected for this study. Three methods were used to evaluate gingival thickness namely visual assessment, visual assessment with the use of periodontal probe and direct measurement using a caliper after extracting the hopeless tooth. One trained examiner performed all examinations. Patient demographics, tooth position, and the results of three assessments were recorded. The mean and standard deviation of gingival thickness were calculated. The three methods were compared using the chi-square test.

Results: The accuracy of visual assessment method for the “thin biotype” was 96.7% [positive predictive value (PPV)=96.7%], while it was 10.3% for “thick biotype” [negative predictive value (NPV)=10.3%]. The accuracy of visual assessment with the use of periodontal probe for the thin biotype was 100% (PPV=100%), while it was 17.1% for the thick biotype (NPV=17.1%). The results of visual assessment method alone and with the use of periodontal probe were incorrect in 37% and 29% of the cases, respectively and this difference was significant ($P<0.01$).

Conclusion: Gingival biotype identification by assessment with the use of periodontal probe is an adequately reliable method while visual assessment of gingival biotype by itself is not sufficient for proper diagnosis.

Key Words: Gingiva, Periodontium, Mouth Mucosa

✉ Corresponding author:
F. Sarlati, Associate Professor,
Department of Periodontics,
Dental Branch, Islamic Azad
University, Tehran, Iran

f_sarlati@dentaliu.ac.ir

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Introduction

During the recent years, characteristics of the oral mucosa, especially gingival thickness have been placed under scrutiny both from an epidemiologic and therapeutic points of view. In 1969, Ochsenbein and Ross [1] subcategorized the morphology of gingiva into "scalloped and thin" or "flat and thick" biotypes. They suggested that there is conformity between gingival contour and the contour of the alveolar bone underneath. Later,

Seibert and Lindhe [2] introduced the term “periodontal biotype” to classify the gingiva into "thick-flat" and "thin-scalloped" biotypes. “Periodontal biotype” is a term introduced to define gingival thickness in buccolingual dimension (thick or thin) [3-9]. Periodontal biotype is one of the most important factors that alters the success rate of dental procedures such as periodontal and restorative treatments, root coverage procedures, orthodontic treatment and

implant placement. A thin gingival biotype requires special care and as a result, identifying tissue biotype prior to any dental procedure is critical [4, 6, 10-18].

Many invasive and non-invasive methods have been suggested to measure the gingival thickness such as direct visual assessment [1,2], probe transparency [4,19,20], direct measurement [12,21-23], ultrasonic devices [24-26] and cone-beam computed tomography [27-30]. Probe transparency and visual assessment can only distinguish thick from thin biotype, while direct measurement can truly calculate the gingival thickness. The objective of this study was to assess the reliability of visual assessment of facial gingival biotype of maxillary and mandibular teeth with or without the use of periodontal probe in comparison with direct measurement.

Materials and Methods

In this diagnostic study, 67 systemically healthy, non-smoking patients (25 women and 42 men) with a mean age of 36.02 years (range 18-66 years) referred for dental treatment with a total of 100 hopeless teeth were selected based on the following inclusion and exclusion criteria: Patients had to be 18 years old or older at the time of extraction and had to have good oral hygiene, at least one hopeless tooth (other than molars) due to fracture or periodontal or endodontic problems, no history of periodontal plastic surgery (root coverage, gingival tissue graft, crown lengthening, guided tissue regeneration) and having at least 3mm distance from the gingival margin to the underlying buccal bone of hopeless tooth determined by the bone sounding technique [19]. Patients were excluded if: they had crowns or marginal restorations, if there was infection or inflammation around the free gingival margin of hopeless tooth, were pregnant or nursing, were taking medications with known effects on periodontal soft tissue, had a medical or dental history that would compromise the outcome of the study such as alcohol or drug dependence, mouth breathing and smoking. All subjects who agreed to participate in the study signed an informed consent form.

Measurement of gingival thickness:

The following methods were used to evaluate the

gingival thickness of the hopeless tooth:

1- Visual assessment: Clinical evaluation was done based on the general appearance of the gingiva around the hopeless tooth. The general biotype was divided into two groups: Thick if the gingiva was dense and fibrotic and thin if the gingiva was delicate, friable and transparent [2,9,17].

2-Visual assessment with the use of periodontal probe: Clinical evaluation of the gingival biotype of each hopeless tooth was done by sulcus probing of the midfacial aspect of the hopeless tooth using a periodontal probe (Williams; Hu-Friedy, Chicago, IL, USA). The gingival biotype was subcategorized into thin, when the periodontal probe was visible and thick, when the probe was not visible through the gingival tissue [19].

3- Direct measurement using a caliper: Each hopeless tooth was extracted with minimal trauma using a periosteal elevator. Then, the gingival thickness was measured promptly at approximately 2mm apical to the gingival margin on the midfacial aspect of the extraction socket, directly by a wax caliper (Mega dental GmbH, Bodingen, Germany), which was modified by cutting the spring. This way the tension of the caliper arms was avoided to hamper the excessive pressure on the gingival tissue [31]. Whilst measuring, the modified caliper was held by the examiner and the gingival thickness was recorded with the precision of 0.1mm by an assistant, who was not involved in the study. The gingival biotype was considered thin if the measurement was $\leq 1.0\text{mm}$ and it was considered thick if it measured $>1.0\text{mm}$ [31].

One trained examiner performed all examinations. The data recorded from each patient included: Patient demographics, tooth position and the results from the three assessments. The mean and standard deviation values were calculated for the gingival tissue thickness. The assessment methods were compared using the chi-square test at a significance level of $\alpha=0.05$.

Results

One hundred hopeless teeth in 67 patients (25 women, 42 men) with a mean age of 36.02 years (range 18 to 66 years) were evaluated. There were 63 hopeless maxillary and 37 hopeless mandibular teeth. Based on the direct measurement method (measuring the thickness of the gingiva by a

caliper), 6% of the samples were thick and the rest were thin (94%). Table 1 shows the distribution of samples (thin and thick) using visual assessment only and direct measurement methods. The results indicated that the accuracy of the visual assessment method for the thin biotype was 96.7% [positive predictive value (PPV)=96.7%], while it was 10.3% for the thick biotype [negative predictive value (NPV)=10.3%].

Table 2 shows the distribution of samples (thick and thin) using visual assessment with the use of periodontal probe and direct measurement methods. The results indicated that the accuracy of the visual assessment with the use of periodontal

probe for the thin biotype was 100% (PPV=100%), while it was 17.1% for the thick biotype (NPV=17.1%).

Table 3 indicates the distribution of samples according to the correct (NPV and PPV) and incorrect (false positive and false negative values) diagnoses, using visual assessment only and visual assessment with the use of periodontal probe methods. The results indicated that 37% of the results of the visual assessment method and 29% of the results of the visual assessment with the use of periodontal probe were incorrect. Chi-square test showed that this difference was statistically significant ($P<0.01$).

Table 1. Distribution of the samples according to the thin and thick biotype determined by visual assessment and direct measurement methods

Direct measurement Visual assessment	Thin	Thick	Total
	Thin	Thick	Total
Thin	59	2	61
Thick	35	4	39
Total	94	6	100

Table 2. Distribution of the samples according to the thin and thick biotypes determined by visual assessment with the aid of a periodontal probe and direct measurement methods

Direct measurement Visual assessment with probe	Thin	Thick	Total
	Thin	Thick	Total
Thin	65	0	65
Thick	29	6	35
Total	94	6	100

Discussion

In the present study, two different methods for gingival biotype identification and their reliability in comparison with direct measurement method were assessed. These two non-invasive methods for determining the gingival thickness were visual assessment and assessment with a periodontal probe. Since there is no universal standard for visual assessment and it heavily depends upon the examiner's clinical experience, this method is

subjective. Assessment with a periodontal probe, on the other hand, is an objective method relying on the visibility of the underlying periodontal probe during evaluation.

The results of the present study showed that there was a significant statistical difference between the visual assessment and other methods (assessment with a periodontal probe and direct measurement) in identifying the gingival biotype, which concurs with the results of studies conducted by Kan et al,

Table 3. Distribution of the samples according to correct and incorrect diagnoses in visual assessment only and visual assessment with the aid of a periodontal probe

Diagnosis Methods	Correct (NPV + PPV)	Incorrect (FPV + FNV)	Total
Visual assessment	63(63)	37(37)	100
Visual assessment with probe	71(71)	29(29)	100

NPV: Negative predictive value

PPV: Positive predictive value

FPV: False positive value

FNV: False negative value

[31] and Olsson et al, [23] who did not find an association between the visually scalloped-thin/flat-thick periodontal biotype and the measured thin/thick gingiva.

In our study, 85% of cases were identified as thin by visual assessment, while direct measurement categorized only %51 of these cases as thin gingival biotype. Therefore, visual assessment is neither acceptable nor reliable in predicting gingival thickness, especially in gingival esthetic treatment planning prior to surgical and restorative procedures.

Meanwhile, the gingival tissue's capability of covering the underlying material is momentous for the future esthetic results [4,32-36], especially in restorations where alloys are used subgingivally, like implants and metallic restorations. Thus, the most rational and minimally invasive method for gingival tissue thickness evaluation is metal periodontal probe [19]. These findings confirm that assessment with a periodontal probe is an adequately reliable and objective method for evaluation of gingival biotype, which is in accordance with similar previous studies conducted by Kan et al, [31] and Olsson et al [23]. While being the most objective method, direct clinical measurement might bring some controversies. Tension-free caliper which was used in this study, can only be used in surgeries and not for pretreatment evaluation. The mean gingival thickness in this study was 0.96 ± 0.25 mm ranging from 0.5 to 1.4 mm, which is similar to that reported in the literature (0.7 to 1.5 mm) [23,25,31,35,37-40]. Gingival biotype plays a major role in treatment planning such as in

restorative and regenerative treatments, implant therapy and plastic mucogingival surgery [41]. Therefore, it is necessary to identify tissue biotype before treatment. Frost et al. [42] failed to identify a gingival thickness threshold that can reliably discriminate between sites where the probe was visible (i.e., thin biotype) and where it was not visible (i.e., thick biotype). Although they reported that gingival thickness > 0.8 mm most closely corresponded to probe invisibility.

Thick gingival biotype distribution was reported to be %15 via visual assessment, which was lower than the results of direct measurement (%49) in another visual assessment study [31]. This emphasizes the fact that visual assessment of gingival biotype is not reliable for appropriate diagnosis and treatment planning for adequate gingival esthetics prior to surgery and restoration treatments.

Conclusion

Within the limitations of this study, the following conclusions can be drawn:

- 1-Visual assessment of gingival biotype by itself is not sufficient for proper diagnosis and treatment planning.
- 2-Gingival biotype identification by assessment with a periodontal probe is an adequately reliable and objective method.

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