Gingival Biotype Assessment in the Esthetic Zone: Visual Versus Direct Measurement

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This study evaluated the reliability of assessing visually the facial gingival biotype of maxillary anterior teeth with and without the use of a periodontal probe in comparison with direct measurements. Forty-eight patients (20 men, 28 women) with a single failing maxillary anterior tooth participated in this study. Three methods were used to evaluate the thickness of the gingival biotype of the failing tooth: visual, periodontal probing, and direct measurement. Prior to extraction, the gingival biotype was identified as either thick or thin via visual assessment and assessment with a periodontal probe. After tooth extraction, direct measurement of the gingival thickness was performed to the nearest 0.1 mm using a tension-free caliper. The gingival biotype was considered thin if the measurement was ≤ 1.0 mm and thick if it measured > 1.0 mm. The assessment methods were compared using the McNemar test at a significance level of α = .05. The mean gingival thickness obtained from direct measurements was 1.06 ± 0.27 mm, with an equal distribution (50%) of sites with gingival thicknesses of ≤ 1 mm and > 1 mm. The McNemar test showed a statistically significant difference when comparing the visual assessment with assessment using a periodontal probe (P = .0117) and direct measurement (P = .0001). However, there was no statistically significant difference when comparing assessment with a periodontal probe and direct measurement (P = .146). Assessment with a periodontal probe is an adequately reliable and objective method in evaluating gingival biotype, whereas visual assessment of the gingival biotype by itself is not sufficiently reliable compared to direct measurement. (Int J Periodontics Restorative Dent 2010;30:237–243.)

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The term *gingival biotype*[1–7] has been used to describe the thickness of the gingiva in the faciopalatal dimension. It has been suggested that a direct correlation exists between gingival biotype and the susceptibility to gingival recession following surgical and restorative procedures.[2,4,8–16] Therefore, an accurate diagnosis of gingival tissue biotype is of the utmost importance in devising an appropriate treatment plan and achieving a predictable esthetic outcome.

In general, gingival biotype can be evaluated by direct visual assessment only,[17,18] visual assessment with the aid of a periodontal probe,[2,19,20] and direct measurements.[10,21–23] While gingival biotype can only be identified as either thick or thin with visual assessment methods, true gingival thickness can be recorded using direct measurements. Nevertheless, there has not yet been an objective classification to determine the gingival tissue thickness of different biotypes. The purpose of this study was to evaluate the reliability of visually assessing the facial gingival biotype of maxillary anterior teeth in comparison with direct measurements.

Method and materials

Patient selection

This study was approved by the Institutional Review Board of Loma Linda University and was conducted at the Loma Linda University School of Dentistry Center for Prosthodontics and Implant Dentistry, Loma Linda, California. Patients were selected according to the following inclusion and exclusion criteria.

Patients must have been 18 years of age or older at the time of extraction with good overall oral hygiene; possess a single failing maxillary anterior tooth without prior guided tissue regeneration, root coverage, crown lengthening, or gingival tissue graft procedures; present an adequate and harmonious gingival architecture with the surrounding dentition; and present a free gingival margin to the underlying bone dimension of 3 mm or greater on the labial aspect of the failing tooth, ascertained by the bone sounding technique.[19] Patients were excluded if there was a known presence of infection or inflammation around the free gingival margin of the failing tooth or if they had a medical or dental history that would compromise the outcome of the study, such as alcohol or drug dependency, a history of smoking, mouth breathing, poor health, or any other medical, physical, or psychologic reason.

Clinical procedure

All patients involved in this study received comprehensive treatment planning and a diagnostic work-up and consented to the treatment protocol. Three methods were used to evaluate the thickness of the gingival biotype of the failing tooth: visual, periodontal probing, and direct measurement. The gingival biotype of the failing tooth was first evaluated by visual assessment and then assessed using a periodontal probe. Immediately after the minimally traumatic extraction of the failing tooth, direct measurements of the gingival biotype were made using a modified caliper. All examinations were performed by one of two examiners, and both examiners were calibrated prior to the commencement of the study.

Visual evaluation

The examiners were calibrated by visually evaluating the gingival biotype of 10 randomly selected maxillary anterior teeth and their respective gingival architecture before the study began. The gingival biotype was clinically evaluated based on the general appearance of the gingiva around the failing tooth. The gingival biotype was considered thick if the gingiva was dense and fibrotic in appearance and thin if the gingiva was delicate, friable, and almost translucent (Fig 1).[7,15,18]

Periodontal probe

The examiners were also calibrated by evaluating the gingival biotype of 10 randomly selected maxillary anterior teeth and their respective gingival architecture using a periodontal probe (SE Probe SD12 Yellow, American Eagle Instruments). The gingival biotype of each failing tooth was evaluated clinically by sulcus probing of the midfacial aspect of the failing tooth (Fig 2). The gingival biotype was categorized as either thin or thick according to the visibility of the underlying periodontal probe through the gingival tissue (visible = thin, not visible = thick).[19]

Direct measurement using a modified caliper

A caliper (Wax Caliper, Pearson) was modified by cutting the spring and therefore eliminating the tension of the caliper arms to avoid excessive pressure on the gingival tissue.[24] The examiners were calibrated so that the gingival tissue thickness was directly measured without any undue pressure to the gingiva at approximately 2 mm apical to the free gingival margin on the midfacial aspect of 10 randomly selected extraction sockets before the commencement of the study (Fig 3). This location was chosen because it is usually still in the keratinized zone and the measurement is unlikely to be obstructed by the facial bone level. Furthermore, it is comparable to the location used during assessment by periodontal probe. During the measurement, the modified caliper was held by one of the two examiners and the gingival thickness was recorded to the nearest 0.1 mm by an assistant, not involved in the study, to add objectivity to the readings. The measurements were made until two duplicate values were registered and recorded. The gingival biotype was considered thin if the measurement was ≤ 1.0 mm and thick if it measured > 1.0 mm.

Fig 1 *Thick gingival biotype as identified by visual assessment.*

Fig 2 *Thick gingival biotype as identified using a periodontal probe.*

Fig 3 *Direct measurement of gingival thickness (1.0 mm) using a tension-free caliper.*

Data collection and analysis

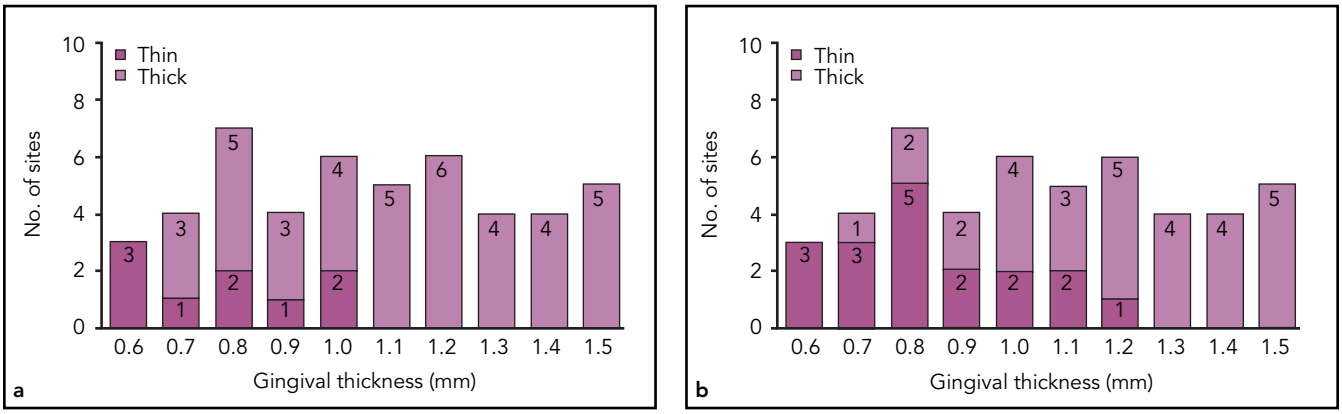
The following data were recorded from each patient: patient demographics, tooth position, mode of failure, bone sounding of the midfacial aspect of the failing tooth, and the results from the three assessments. Means and standard deviations were calculated for the gingival tissue thickness. The assessment methods were compared using the McNemar test at a significance level of $\alpha = .05$.

Results

Forty-eight patients (20 men, 28 women) with a total of 48 failing maxillary anterior teeth and a mean age of 51.8 years (range, 18 to 86 years) participated in this study. There were 23 failing central incisors, 15 failing lateral incisors, and 10 failing canines. Tooth failures were attributed to caries (n = 7), fracture (n = 15), endodontic failure (n = 12), periodontal failure (n = 6), and root resorption (n = 8). Visual assessment resulted in 39 sites (81%) with a thick gingival biotype and 9 sites (19%) with a thin gingival biotype, whereas 30 (62.5%) and 18 (37.5%) sites were recorded for thick and thin gingival biotypes, respectively, when assessed using a periodontal probe. The mean gingival thickness obtained from direct measurement was 1.06 ± 0.27 mm (range, 0.6 to 1.5 mm). When categorized by gingival biotype, 24 sites (50%) were considered thick (> 1.0 mm) and 24 sites (50%) were considered thin (≤ 1.0 mm).

Frequency distribution of the gingival thickness from direct measurement versus gingival biotype (thick or thin) by visual assessment showed that the biotype was always thin (100%) when the gingival thickness was 0.6 mm and always thick (100%) when the gingival thickness was > 1.0 mm (Fig 4a). For gingival thicknesses between 0.7 and 1.0 mm, the frequency distributions of thin (25% to 33%) and thick (67% to 75%) biotypes were relatively constant, with a greater predisposition toward the thick gingival biotype (Fig 4a).

Frequency distribution of the gingival thickness from direct measurement versus gingival biotype (thick or thin) assessed with a periodontal probe showed that the biotype was always thin (100%) when the gingival thickness was 0.6 mm and always thick (100%) when the gingival thickness was > 1.2 mm (Fig 4b). For gingival thicknesses between 0.7 and 1.2 mm, the frequency distributions displayed a descending trend in thin gingival biotype (from 75% to 17%) and an ascending trend in thick gingival biotype (from 25% to 83%) as the gingival tissue increased in thickness (Fig 4b).



Figs 4a and 4b *Distribution of gingival thickness from direct measurement versus gingival biotype (thick or thin) by* (a) *visual assessment and* (b) *periodontal probe.*

The McNemar test showed statistically significant differences in the way gingival biotype was identified when comparing visual assessment with assessment using a periodontal probe (*P* = .0117, Table 1) and direct measurement (*P* = .0001, Table 2). However, there was no statistically significant difference when assessment using a periodontal probe was compared to direct measurement (*P* = .146, Table 3).

Discussion

Although a thin gingival biotype has been associated with a propensity to gingival recession following restorative, periodontal, and implant surgical procedures, the methods of gingival biotype identification in these studies were primarily visual assessment or assessment with a periodontal probe.[2,4,5,11,14,19,23,25] There is no universal standardization of visual assessment, which relies heavily on the clinical experience of the examiner and is therefore subjective. Assessment with a periodontal probe, on the other hand, provides some objectivity with the visibility, or lack thereof, of the underlying periodontal probe during evaluation. However, the degree of gingival thickness cannot be expressed with this assessment and can only be verified with a direct measurement.

The results of this study show that gingival biotype identification by visual assessment was statistically significantly different from assessment with a periodontal probe and direct measurement (*P* < .05, Tables 1 and 2). This concurs with the study conducted by Olsson et al,[23] in which a lack of asso-

Table 1 Comparison of frequency distribution of gingival biotype recorded using periodontal probe against visual assessment

	Gingival biotype (VA)	
Gingival biotype (PP)	Thick	Thin
Thick	29	1
Thin	10	8

P = .0117.
PP = periodontal probe; VA = visual assessment.

Table 2 Comparison of frequency distribution of gingival biotype recorded using direct measurement against visual assessment

	Gingival biotype (VA)	
Gingival biotype (DM)	Thick	Thin
Thick (> 1.0 mm)	24	0
Thin (≤ 1.0 mm)	15	9
Predictive value of VA	24/39 (62%)	9/9 (100%)

P = .0001.
DM = direct measurement; VA = visual assessment.

Table 3 Comparison of frequency distribution of gingival biotype recorded using direct measurement against assessment with periodontal probe

	Gingival biotype (PP)	
Gingival biotype (DM)	Thick	Thin
Thick (> 1.0 mm)	21	3
Thin (≤ 1.0 mm)	9	15
Predictive value of PP	21/30 (70%)	15/18 (83%)

P = .146.
DM = direct measurement; PP = periodontal probe.

ciation between the visually scalloped-thin/flat-thick periodontal biotype and the measured thin/thick gingiva was observed. In this study, visual assessment identified gingival thicknesses of 0.6 mm and > 1 mm as thin and thick gingival biotypes, respectively, 100% of the time. It is interesting to note that visual assessment produced the highest predictive value (9 of 9 [100%], Table 2) when identifying thin gingival biotype; that is, when the gingiva was visually thin, it was always ≤ 1.0 mm. The predictive value for thick gingival biotype (> 1 mm) identification was low (24 of 39 [62%], Table 2). Furthermore, the visual assessment seemed to be unable to differentiate gingival thicknesses between 0.7 and 1.0 mm, since the frequency distributions of thin (25% to 33%) and thick (67% to 75%) biotypes were relatively constant, with a greater predisposition toward the thick gingival biotype (Fig 4a). This misinterpretation may have a significant impact on treatment planning, and eventually, the final outcome.

The ability of the gingival tissue to conceal any underlying material is important in achieving esthetic results,[2,26] especially in restorative and implant dentistry, where subgingival alloys are present extensively. Therefore, using the metal periodontal probe to evaluate gingival tissue thickness[19] is a logical and minimally invasive method since periodontal probing and bone sounding procedures are routinely performed during esthetic restorative, periodontal, and implant treatments. The results from this study show that gingival biotype identification by assessment with a periodontal probe was not statistically significantly different from direct measurement (*P* = .146, Table 3). Similar to visual assessment, gingival thicknesses of 0.6 mm and > 1.2 mm were identified

as thin and thick gingival biotypes, respectively, 100% of the time by assessment with a periodontal probe. A moderately high predictive value (15 of 18 [83%], Table 3) for thin gingival biotype (≤ 1.0 mm) identification was also observed with periodontal probing. Although the predictive value for thick gingival biotype (> 1 mm) identification was not high (21 of 30 [70%], Table 3), unlike the visual assessment, the probability of thick gingival biotype identification by assessment with a periodontal probe increased as the gingival thickness increased from 0.7 to 1.2 mm (Fig 4b). These results suggest that assessment using a periodontal probe is an adequately reliable and objective method for evaluating gingival biotype.

While direct measurement is considered the most objective method, its clinical use may provide some challenges. Most published methods require the penetration of the gingival tissue with sharp instruments during the assessment.[10,21,23,26,27] The use of ultrasonic devices,[22,28–30] which would be the most noninvasive method, is deemed practically impossible since they are no longer available commercially (Müller HP, personal communication, 2009). The use of a tension-free caliper,[24] as used in this study, can only be carried out at the time of surgery and cannot be used for pretreatment evaluation. Furthermore, even though the most commonly used dimension to separate thick and thin gingival biotypes is 1.0 mm,[8,16,31] this numerical assignment is at best arbitrary.[32] Regardless, it is worthwhile to note that the mean gingival thickness in this study was 1.06 mm with a range (0.6 to 1.5 mm) that is comparable to that reported in the literature (0.7 to 1.5 mm).[23,29–34] In addition, the results in this study showed an equal distribution (24 of 48 [50%], Tables 2 and 3) of sites with gingival thicknesses of ≤ 1 mm and > 1 mm. While the frequency distribution of thick gingival biotype based on visual assessment in this study (81%) is similar to the prevalence of thick periodontal biotype (85%) reported in another visual assessment study,[35] it is substantially higher than that based on direct measurement (50%). This reiterates the fact that visual assessment of gingival biotype by itself is not sufficient as a predictor for proper diagnosis and treatment planning of gingival esthetics prior to surgical or restorative procedures.

Conclusions

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

- The mean gingival thickness obtained from direct measurement was 1.06 ± 0.27 mm, with equal distribution of sites with gingival thickness of ≤ 1 mm and > 1 mm.
- Gingival biotype identification (thick versus thin) by visual assessment is statistically significantly different from assessment with a periodontal probe and direct measurement.
- Gingival biotype identification by assessment with a periodontal probe is not statistically significantly different from direct measurement and is an adequately reliable and objective method in evaluating gingival biotype.
- Visual assessment of gingival biotype by itself is not sufficient as a predictor for proper diagnosis and treatment planning of gingival esthetics prior to surgical and restorative procedures.

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