Heal Talk

Gingival Biotype : Unfolding the Tale of Pink

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Abstract

The term gingival biotype refers to the soft tissue quality of profile pertaining to that teeth. Various tissue biotypes respond differently to inflammation and to surgical and restorative treatment; consequently, it is important to identify tissue biotype before treatment. These factors dictate the disease progression, treatment outcome and prognosis. Periodontal biotype evaluation is an important parameter in establishing patient expectations in many complex esthetic procedures by allowing the clinician to predict therapeutic outcome. This paper reviews the various clinical implications and methods of assessment of gingival biotype.

Keywords : Biotype,scalloped,transgingivalmethods,ultrasonography,calipers

How to cite this Article: G R M, Rajendran A. Gingival Biotype : Unfolding the Tale of Pink .HTAJOCD.2019;11(3):27-29

Introduction

The term gingival biotype pertains to the quality of the soft tissue profile surrounding the teeth. The gingival morphology plays an important role in determining the final esthetic outcome. Therefore during treatment planning, it is important to recognize differences in gingival tissue. In 1969, Ochsenbein& Ross indicated that there were 2 main types of gingival anatomy— flat and highly scalloped.[1]

The authors reported that flat gingiva was associated with a square tooth form, while scalloped gingiva was associated with a tapered tooth form and proposed that the gingival contour closely mimics the contour of the underlying alveolar bone. The term periodontal biotypewas used later by Seibert &Lindhe, who classified the gingiva as either thin-scalloped or thick-flat.[2]

The teeth associated with flat gingiva are of square shaped with pronounced cervical convexity. The gingiva of such individuals is wide with more volume, the contact areas between the teeth are large and more apically located, and the interdental papillae are short. Teeth associated with scalloped gingiva have slender teeth, tapered crown form, delicate cervical convexity and minute interdental contact areas that are located close to the incisal edge

The following characteristics have been assigned to each biotype. (Oschenbein and Ross, 1969)

THIN AND SCALLOPED	THICK AND FLAT
Delicate thin periodontium	Thick heavy periodontium
Highly scalloped gingival tissue	Flat gingival contour
Usually slight gingival recession	Gingival margins usually coronal to CEJ
Highly scalloped osseous contours	Thick, flat osseous contour
Minimum zones of keratinized gingiva	Wide zone of keratinized gingiva
Small incisal contact areas	Broad apical contact areas
Triangular anatomic crowns	Square anatomic crowns
Insult results in recession	Insult results in pocket depth or rebundant tissue
Subtle diminutive convexities incervical third of the facial surface	Bulbous convexities in cervicalthird of facial surface

Prevalence:

The thicker biotype was observed to be more prevalent in male population with short, wider forms of maxillary central incisors while the females had thinner biotypes and narrow, long form of maxillary central incisors. Among the different age groups, young group had a thicker biotype compared to older group. The mean papillary height was less in subjects with thicker biotypes[3]

Factors Affecting Gingival Biotype & Gingival Bioform

The different parameters which affect the two morphologic types (biotype and bioform) are gingival complex, tooth morphology, contact points, hard and soft tissue considerations, gingival bioform, and biotype. Hence, a clinician's knowledge of anatomy, form, and function of the dentition is of paramount importance in achieving optimal treatment outcomes. It has long been known that clinical appearance of healthy marginal periodontium differs from subject to subject and even among different tooth types. It has been suggested that many features are directly genetically determined, whereas other morphologic characteristics of the periodontium seem to be influenced by tooth size, shape and position, and biological phenomena such as growth or ageing.[4] Gingival thickness affects the biotype of the gingiva, whereas, crown width (CL): Crown length (CW), papilla height, and gingival width are responsible for determining the gingival bioform.

Crown Width –crown Length Ratio

There was a tendency for a flat gingival architecture to have a lower tooth height-to-width ratio, while a scalloped gingival architecture was associated with a higher tooth height-to-width ratio, but the differences were not statistically significant in every study. It has been observed that individuals having a tapered tooth form usually have a thin, scalloped gingival architecture, and clinically; this has been associated with an increased susceptibility to recession. This theory was further supported by studies demonstrating that central incisors with a narrow crown form had a greater prevalence of recession than incisors with a wide, square form.[5] However, Eger et al on the other hand, failed to observe a meaningful influence of CW/CL ratio on gingival thickness.[6]

Gingival Thickness

It has been suggested that different gingival entities have different tooth shapes.

Many studies have examined the correlation between the tooth shape and gingival biotype. Sanavi et al claimed that the thick and flat periodontal tissues have a rectangular tooth shape, and the thin scallop shaped periodontal tissues have a triangular tooth shape.[7] Olsson and Lindhe reported that long and narrow crowns have thin periodontal tissues and a high likelihood of having gingival recession compared to the thick gingival biotype, suggesting a relationship between the tooth shape and gingival biotype[8]

Age &Sex

The thicker biotype is more prevalent in male population while the female population consists of thin, scalloped gingival biotype. On comparing, the prevalence of gingival biotypes between different age groups, the thick flat biotype is seen in younger individuals while older age group shows thin scalloped gingival biotype. Vandana et al in their study on gingival thickness showed thicker gingiva in younger age group and stated that decrease in keratinization and changes in oral epithelium may be the contributing factors.[9] Chang in his study stated that an inverse relationship has been found to be existing between papilla height and age.[10] Sanavi et al in their review article described that the inter-root bone is more in the thinner biotype.[7] This, in turn, can cause more recession. They also stated that the interproximal papilla does not cover the spaces between two teeth in thinner biotype as compared to thick biotype. This could possibly relate to increased amount of recession and also the presence of thin biotype in older age group.

Chow et al also evaluated various factors associated with the appearance of gingival papillae and found significant associations with age and the crown form and gingival thickness.[11] Olsson et al documented that the central incisors with narrow tooth form had greater amount of recession when compared to incisors with square form.[8] With age, the interdental papilla recedes; this explains the greater

frequency of thin biotype seen with older agegroup.Anterior teeth with narrow zones of attached gingiva are frequently encountered in children. Maynard and Ochsenbein suggested that newly erupted permanent teeth with narrow attached gingiva may run a greater risk of gingival recession.[12]The results of some cross-sectional studies in children, teenagers, and adults indicate that the width of attached gingiva increases with age. In the permanent dentition, the gingival problems are often noticed in the age when children are candidates for orthodontic treatment, and considerable attention has been focused on various therapeutic measures.

Papilla Height

The interdental papilla occupies the interdental or embrasure space and acts as a barrier to protect underlying periodontal structures and also plays an esthetic role.The distance from the contact point to the interproximal alveolar crest has been identified as a critical factor in the presence of a complete papilla, with nearly 100% of papillae filling the gingival embrasure completely if contact point-bone crest distance is $\leq$5 mm.[13]

Few studies have examined factors contributing to the presence and absence of dental papillae. Most focused on the influence of crestal bone height and/or interproximal distance. Many other factors that might influence papillary appearance such as tooth form/shape, gingival thickness and keratinized gingiva/attached gingiva width, distance from the contact point to the bone crest, inter-radicular distance, size of the embrasure space, have never been fully examined, but these have been listed to be relevant factors.There have also been reports showing a positive correlation between gingival thickness and papilla fill. Decrease in papilla height is observed with thin biotype. Limited blood supply is believed to be one of the major reasons why papilla preservation and regeneration are difficult. Thicker tissue may resist collapse and contraction due to increased vascularity and extracellular matrix volume.[14]

In addition, thicker keratinized gingival epithelium may be more resistant to physical damage and bacterial ingress. Therefore, thick gingival biotype has been considered more favorable for achieving optimal aesthetics.

Gingival Width

The keratinized portion of the gingiva on the facial aspect of the teeth extends from the margin of the soft tissue to the mucogingival junction. Not all of the gingiva covering the tooth is attached. The attached portion of the gingiva is clinically defined as the distance from depression below the projection on the external surface of the gingival sulcus to the mucogingivaljunction.There is no minimum width of keratinized or attached gingival tissue necessary to maintain health, provided plaque control is adequate; however, sites with narrow keratinized gingiva have been associated with increased recession when exposed to mechanical trauma or poor oral hygiene,and also, it has been suggested that a wide zone of keratinized and attached gingiva is more desirable than a narrow zone or a total lack of such a zone, because a wide zone would better withstand gingival inflammation, trauma from mastication, tooth brushing and forces from muscle pull and orthodontic procedures.[15]

Gingival Biotype And Periodontal Treatment Planning:

The gingival morphology plays an important role in determining the final esthetic outcome. Therefore during treatment planning, it is important to recognize differences in gingival tissue. Different gingival biotypes respond differently to inflammation, restorative, trauma and parafunctionalhabits.A gingival thickness of >2 mm was considered as thick tissue biotype and a gingival thickness of <1.5 mm was referred as thin tissue biotype.The initial gingival thickness is significant as it may predict the outcome of root coverage procedures and restorative treatments. [16]

Gingival Biotype And Treatment Outcome:

The gingival thickness affects the treatment outcome possibly because of the difference in the amount of blood supply to the underlying bone and susceptibility to resorptionPeriodontal surgical techniques can significantly improve the tissue quality and treatment outcome.Periodontal surgical techniques can enhance tissue quality resulting in a more favourable treatment outcome. Soft tissuegrafting in areas of thin biotypes can enhance the quality ofthe gingival tissue. The best way to convert a thin soft tissue to a thick biotype is through subepithelial connective tissue grafting.Various other soft tissue augmentation proceduresinclude modified roll technique and use of acellular dermal matrix. Tissue keratinization can be improved by oral physiotherapy.Understanding Periodontal biotype is also of importance in orthodontic treatment. Alteration of mucogingival dimensions may occur during orthodontic treatment resulting from proper tooth position within the alveolar bone. It has been demonstrated that the gingival tissue with a little horizontal diameter in the presence of a dental plaque, is more susceptible to apical migration of connective tissue attachment with marginal gingivaespecially near teeth under the influenceof orthodontic force. However, in cases with thin gingiva caused by the prominent position of the teeth, there is no need for pre orthodontic gingival augmentation procedures. The recession and bone dehiscence will decrease when the tooth is moved in amore proper position within the alveolar bone[17]

Gingival Biotype And Underlying Alveolar Bone:

Kan et al in 2003 measured the dimensions of the gingiva by bone sounding at the mesiobuccal and distobuccal aspects of maxillary anterior teeth.Bone sounding determines the distance between the soft tissue margin and the crest of the bone and, hence, provides an estimate that is about 1 mm greater than that obtained in a regular probing pocket depth measurement. The authors reported that the thickness of the gingiva varied between subjects of different gingival biotypes. Thus, the height of the gingiva at the buccalapproximal surfaces in subjects who belonged to the flat biotype was, on average, 4.5 mm, while in subjects belonging to the pronounced scalloped biotypethe corresponding dimension on an average of 3.8 mm was significantly smaller. This indicates that subjects who belong to the flat biotype have more voluminous soft approximal tissues than subjects who belong to the pronounced scalloped biotype.[18]

Pontoriero et al in 2001 performed evaluations of the reformation of the gingival unit at the buccal aspect of teeth exposed to crown lengthening procedures using a denudation technique.[19] At the 1 year follow up examination after surgery the regain of soft tissue measured from the level of the denuded osseous crest was greater in patients with a thick biotype than in those with a thin biotype. No assessment was made of the bone level change that had occurred between the baseline and the follow up examination. It must, however, be anticipated that some bone resorption had taken place during healing and that the biologic width of the new connective tissue attachment had been re established coronal to the level of the resected osseous crest

Gingival Biotype And Root Coverage:

Thickness of tissues in the recipient site and the donor site are key factors in treating mucogingivaldefects. In cases involving root coverage procedures, a flap thickness of 0.8-1.2 mm produced more predictable outcomes. An initial gingival thickness was found to be the most predictable factor for predicting the success of complete root coverage procedures.There is a correlation between flap thickness and complete root coverage.A thick tissue has an increased blood supply that will enhance the revascularization of grafts, leading to increased healing and graft incorporation and hence there are more chances of complete root coverage in thick biotype.[20]

Gingival Biotype And Crown Lengthening Procedures:

Thick gingival tissues are more resistant to mucosal recession or mechanical irritation and are capable of creating a barricade to conceal restorative margins.

With crown lengthening procedures, it is often difficult to predict the final position of the soft and hard tissues, due to the fact that each time when a flap is reflected, there is at least 0.5–0.8 mm of bone loss. There could be undue gingival recession following surgery. So before placement of permanent restoration in the anterior region a healing period of at least six months is desirable. In an extremely thin gingival tissue, soft tissue grafting is recommended 6–8 weeks prior to surgical crown lengthening to improve the thickness of the keratanized tissue[21]

Gingival Biotype And Ridge Preservation:

Thick biotypes show greater dimensional stability during remodeling compared to thin biotypes. A thin gingival biotype is associated with a thin alveolar plate. More ridge remodeling has been found in thin biotype when compared with thick periodontal biotype. Ridge preservation should be considered for most thin biotype cases. Preservation of alveolar dimensions such asatraumatic extraction, socket preservation or ridge preservation techniques after tooth extraction is critical for achieving optimal esthetic results in thin biotypes[22].

Gingival Biotype And Implant Therapy:

Evidence suggests that the percentage of the success rate of immediate implants in anteriors is more in individuals with thick biotypes. However in patients with thin biotypes the frequency of gingival recession is high following implant restoration.The thicknesses of the crestal bone on the buccal aspect

significantly influenceremodeling during the initial four month healing period after immediate implant placement. A delayed implant must be considered when there is not enough soft and hard tissue thickness. However immediate implants can be considered with predictable results in thick biotypes.

Gingival Biotype And Maxillary Sinus lining:

Aimetti et al in 2008 took maxillary mucosal biopsies from the sinus floor during otorhinolaringologicsurgical interventions, and measured gingivalthickness in the area of the maxillary anterior teeth.[23] The authors reported that the average thickness of the Schneiderian membrane was 0.97 ± 0.36 mm. Patients with thick gingiva had a sinus mucosa that was 1.26 ± 0.14 mm thick, compared to 0.61 ± 0.15 mm thickness among patients with thin gingiva. The results showed that gingival thickness is a reliable factor for predicting sinus membrane thickness. However research on this is still in its infancy

Methods To Measure Gingival Biotype

Many Invasive and non invasive methods have been used to evaluate the thickness of facial gingival and other parts of the masticatory mucosa[24].The method of assessment of gingival biotype ranges from assessment with periodontal probe, probe transparency visual examination, ultrasonic devices or radiographic methods to conventional histology on cadaver jaws, injection needles, transgingival probing, histologic sections, cephalometric radiographs and Cone beam computed tomography.[25]

Visual Evaluation

Simple visual evaluation is used in clinical practice to identify the gingival biotype; however, it may not be considered a reliable method, as it cannot be used to assess the degree of gingival thickness.[26]

Probe Transparency

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, where subgingival metal restorations are used widely. Using a metal periodontal probe in the sulcus to evaluate gingival tissue thickness is the simplest way to determine gingival biotype; with a thin biotype, the tip of the probe is visible through the gingiva. This method is minimally invasive and can be performed routinely during periodontal probing procedures.[27]

Modified Caliper

A tension free caliper can only be used at the time of surgery and cannot be used for pre-treatmentevaluation. A 2010 study by Kan et al of the facial gingival biotype in maxillary anterior teeth compared visual evaluations, the use of a periodontal probe, and direct measurements with a tension free caliper.The authors reported a statistically significant difference between visual assessment and both the periodontal probe and the tension free caliper; however, there was no statistically significant difference when comparing the periodontal probe assessment and the tension free caliper. Based on these results, a periodontal probe in the sulcus is an adequately reliable and objective way to evaluate tissue thickness, whereas visual evaluation of the gingival biotype by itself is not as reliable as the periodontal probe or the tension-free caliper.[28]

Transgingival Probing

Gingival thickness can be measured by using a periodontal probe; however,
such measurements can be affected by the precision of the probe, the angulation of the probe, and the distortion of the tissue during probing.[29]

Ultrasonic Devices

A 1971 study by Kydd et al was the first to measure the thickness of palatal
mucosa using an ultrasonic device. Ultrasonic devices appear to be the least invasive method and offer excellent validity and reliability. However, such devices are no longer available commercially; in addition, they make it difficult to both determine the correct position for accurate measurement andsuccessfully reproduce measurements.[30]

Cone Beam Computed Tomography (CBCT)

CBCT scans have been used extensively for hard tissue imaging because of their superior diagnostic ability. CBCT measurements may be a more objective method than direct measurement.Thickness of alveolar bone plate surrounding the tooth is associated with the type of biotype. Thick buccal bony plate usually corresponds to thick gingival biotype. Measuring the thickness of bony plate by CBCT can be a noninvasive method for assessing type of gingival biotype.[31]

Puffed cheek method

Dvorak et al in 2013 described this method in a case series where they assessed the thickness of mucosa by using computed tomography with splint placed to localize the exact position by a marker points. Marker points were placed at four sites. The Four sites were evaluated two central incisors and two first molars. Patients were asked to puff out cheeks because, Computed tomography scans with distended cheeks provide a more detailed evaluation of mucosal surfaces of the oral cavity than conventional CT scans.[32]

Conclusion

Different tissue biotypes exhibit different pathological responses when subjected to inflammatory, traumatic or surgical insults as they have different gingival and osseous structures. These different responses, dictate different treatment modalities. The current periodontal surgical techniques have the potential to improve the tissue quality, thereby enhancing the restorative environment. With the knowledge of the nature of tissue biotypes, clinicians can employ appropriate periodontal management to minimize tissue resorption and provide more favourable results after treatment. So by taking into consider
ation the gingival tissue biotypes during treatment planning, more appropriate strategies for periodontal management may be developed, resulting in more predictable treatment outcomes.

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