



INDICES FOR RECORDING GINGIVAL ENLARGEMENT/ OVERGROWTH: A CHRONOLOGICAL REVIEW AND UPDATE

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ABSTRACT

Gingival Enlargement (GE), also called as Gingival Overgrowth (GO), is an increase in size of gingiva, clinically appreciated as a swelling of gums. This swelling can be attributed to either increase in size or number of cells which is clinically indistinguishable. Therefore, certain histopathological terminologies such as Gingival Hyperplasia or Hypertrophic Gingivitis, used formerly, have been cast off. It is a very common feature associated with gingival pathology. Various aetiologies such as drugs, inflammation, physiology, systemic diseases and neoplasm have been identified to be causal in development of gingival enlargement. Apart from identifying these etiological factors, assessment and recording the gingival enlargement plays an equivalently significant role in treatment planning. Numerous researchers have proposed respective indices to record the overgrowth. We will discuss these indices to measure the gingival overgrowth in the present informative review article.

INTRODUCTION

Gingival enlargement of labial or buccal gingiva is an esthetically disfiguring clinical entity and it is frequently these changes in aesthetics that drives the patient to a doctor. Difficulties with pronunciation and impaired clarity of speech occur due to enlargement of the lingual and palatal gingival tissues. Moreover, gingival enlargement leads to impairment of routine oral hygiene practices. However, if the soft tissue encroaches onto the occlusal surface of the teeth, it may interfere with the masticatory function thereby resulting in pain and discomfort.

Alterations in gingival contour seen in patients with gingival overgrowth have been classified using various indices. Anecdotally, indices were proposed based upon vitamin C levels owing to its clinical resemblance to scurvy or scorbutic gingivitis. Also, there exists an index based upon histopathological interpretation of epithelium and rete pegs. Commonly, indices proposed are in the form of ordinal scales such as mild, moderate or severe or according to coverage of the tooth surface. Although these indices seem very similar, the actual definition may be variable as proposed by individual author per se. A number of authors have used probing depths (vertical plane), gingival width (horizontal plane) or both for assessment of gingival overgrowth. The basic limitation of these indices is that all of them are, by default, subjective in

nature. To overcome this limitation, certain techniques of objective evaluation have been put forth, majority of which deal with volumetric analysis by means of digitalization i.e. photography and laser scan.

The present review article will focus on all these indices to measure gingival enlargement.

Kimball (1939) (1), upon analyzing blood vitamin C levels of patients undergoing phenytoin therapy, discovered very low Vitamin C levels which he correlated with the clinical severity of gingival hyperplasia. He proposed a gradation, one of its earliest kind, as described in Table 1:

Table 1 Kimball index

GROUP	Mg per 100 Cc
Normal	1.14
One plus	0.58
Two plus	0.55
Three plus	0.47

Robinson (1942) (2) observed gingival overgrowth changes as an invariable characteristic progression; hence, he could describe them in possibly 5 stages of progression of gingival enlargement whereas Harris and Ewalt (1942) (3) restated the classification of stages developed by Robinson.

Ingle JI (1959) (4) recorded the pseudopocket depth readings with a Williams's periodontal probe and three readings from

the labial gingiva of each of the maxillary and mandibular anterior teeth i.e. distance from height of the distal papilla, labial margin, and mesial papilla to the incisal edge with a millimeter scale. An average measurement was obtained that were converted to percentages and charted as an increase or decrease in tissue level.

Aas (1963) (5) developed a gingival index using 4 grades ranging from slight to very severe gingival enlargement.

Angelopoulos AP, Goaz PW (1972) (6) graded the noteworthy gingival enlargement as follow (Table 2):

Table 2 Angelopoulos and Goaz index

GRADE	FEATURES
Grade 0	No hyperplasia; normal gingiva
Grade 1	The hyperplastic gingiva covered the cervical third or less of the anatomic crowns of the anterior teeth
Grade 2	The hyperplastic gingiva extended anywhere in the middle third of the anatomic crowns of the anterior teeth
Grade 3	The hyperplastic gingiva covered more than two thirds of the anatomic crowns of the anterior teeth

Conard (1974) (7), in his study, recorded oral hygiene (0 to 2 scale; zero- good oral hygiene and two- poor) and level of inflammation (0 to 2 scale; zero- absence of clinical signs of inflammation and two- severely inflamed gingiva). Hyperplastic gingival tissue was surgically removed in segments from four to six teeth, and each segment was classified to degree of hyperplasia (0 to 4 scale; zero indicates no clinical signs of hyperplasia and four indicates the teeth were completely covered with hyperplastic tissue). Vogel (1980) (8) evaluated gingival enlargement in an animal study using the hyperplasia index described by Harris and Ewalt.

Hassell *et al.* (1984) (9) proposed an objective method of scoring the three dimensional changes with the help of dental models. They were sectioned, photographed followed by superimposition with a second image of a scale grid. Grid squares were counted, and the total number of complete grid squares for all the cut surfaces were divided by the number of surfaces (teeth) counted in order to obtain a score.

Seymour (1985) (10) graded gingival enlargement on study casts. He divided upper and lower anterior segments 5 gingival units each both buccally and lingually. The degree of gingival enlargement and their encroachment upon adjacent teeth were

Table 3 Seymour index

Gingival enlargement grade	
0	Normal
1	thickening from the normal up to 2 mm
2	thickening from the normal greater than 2 mm

A higher score was given in case of a discrepancy and the 2 scores (thickening and gingival encroachments) added thereby giving a maximum score of 5 for each gingival unit. The degree of enlargement around upper and lower anterior teeth is expressed as percentage.

Daley *et al* (1986) (11) classified the degree of gingival hyperplasia from 0 to 5 to each interdental papilla on both buccal and lingual sides whereas Friskopp and Klintmalm (1986) (12) classified gingival enlargement in 3 categories as minute to severe.

Dahllof G & Modeer T (1986) (13) graded gingival enlargement on the basis of the thickness of marginal gingiva on the stone casts, measured from the buccal surface of the

tooth to the most prominent area of the marginal gingiva, in incisor and first permanent molar regions in both upper and lower jaws. The most cervical point on the buccal tooth surface was used as a reference point.

McGaw (1987) (14) assessed gingival overgrowth using a modification of the semi-quantitative index developed by Aas (Table 4) and divided the patients into 2 groups, responders and non-responders (gingival overgrowth score of grade 1 or less).

Table 4 McGaw index

GRADE	CRITERIA
0	No overgrowth; feather edged gingival margin
1	Blunting of gingival margin
2	Moderate gingival overgrowth (<1/3 rd of crown length)
3	Marked gingival overgrowth (>1/3 rd of crown length)

Barak (1987) (15) recorded gingival enlargement based on histological analysis. Based upon the length of the rete pegs (acanthosis), he gave the following index (Table 5):

Table 5 Barak Index

GRADE	LENGTH OF EPITHELIUM
1	Normal gingiva, width of epithelium from 0.30 to 0.50 mm
2	Slight hyperplasia, width of epithelium from 0.50 to 1.50 mm
3	Moderate hyperplasia, width of epithelium from 1.50 to 3.00 mm
4	Severe hyperplasia, width of epithelium from 3.00 to 4.00 mm

Drew (1987) (16) measured gingival hyperplasia by the use of the projected Kodachrome slides and study casts. The hyperplasia index measured the degree of extent of gingival hyperplasia as follows (Table 6):

Table 6 Drew index

SCORE	FEATURES
0	gingiva exhibited no clinical signs of hyperplasia
1	Minimal hyperplasia; increase in density of the gingiva with marked stippling and a granular appearance.
2	Moderate hyperplasia; an increase in the size of the interdental papilla and noticeably rolled gingival margins.
3	Marked hyperplasia; encroachment of the gingival tissues upon the anatomic crown of the tooth.
4	Hyperplasia so severe as to interfere with function.

Heijl and Sundin (1988) (17) used color photographs to assess signs of gingival overgrowth. For each tooth, changes in gingival size were determined according to a Gingival Size Index (GSI) (Table 7), in which the gingival tissues of the mesial, buccal, and distal surfaces of the teeth were evaluated.

Table 7 Heijl and Sundin index

SCORE	GINGIVAL CHANGES
0	No change in size from the initial examination
1	Small but clinically evident size increase
2	Marked increase
3	Extensive increase with the gingival tissues covering the corresponding aspect of the tooth surface and/or with deep clefts into the enlarged gingiva

Pasqualin *et al* (1990) (18) classified gingival enlargement as grades from 0 to 3 based upon the extent of gingival proliferation and the involvement of one or more quadrants.

Kitamura *et al* (1990) (19) measured gingival enlargement as an increased length of the buccal and lingual gingiva. According to Thomason and Seymour (1990) (20) and Seymour and Smith (1991) (21), a gingival overgrowth score

of 30% was considered clinically significant and warranted surgical intervention to restore gingival contour.

Miller and Damm (1992) (22) identified gingival hyperplasia by location and gave gradings according to a modified index (Table 8) originally described by Angelopoulos and Goaz.

Table 8 Miller and Damm index

GRADE	FEATURES
0	No hyperplasia; normal gingiva
1	Minimal hyperplasia; less than 2 mm increased in size and gingiva covered the cervical third or less of the anatomic crown
2	Moderate hyperplasia; 2 to 4 mm increased in size, and/or gingiva extended into middle third of anatomic crown
3	Severe hyperplasia; nodular growth greater than 4 mm increased in size, and/or gingiva covered more than two-thirds of the tooth crown

King *et al* (1993) (23) classified and graded each gingival unit from the study casts of the 12 anterior teeth, using a hyperplastic index (Table 9) consisting of 2 components: the vertical dimension (degree of gingival enlargement in an apicocoronal direction and the horizontal dimension of gingival enlargement). He divided individuals into 2 groups: responders (subjects with a hyperplastic index score greater than 30%) and non-responders (subjects with a hyperplastic index score less than or equal to 30%).

Table 9 King index

Vertical/ apico-coronal component		Horizontal/ labio-lingual component	
0	No gingival hyperplasia	0	Normal width of free gingival margin
1	Mild hyperplasia (blunting of gingival margin)	1	Thickening from the normal upto 2mm
2	Moderate hyperplasia (less than 1/2 of crown length)	2	Thickening from the normal to >2mm
3	Marked hyperplasia (greater than 1/2 of crown length)		

Hefti *et al* (1994) (24) proposed an index which evaluated overgrowth from clinical photographs on a scale ranging from 0 (no visible overgrowth) to 3 (large masses of overgrowth). Somacarrera *et al* (1994) (25) assessed the degree of gingival enlargement from 0, indicating no clinical evidence of overgrowth, to 4, indicating enlargement covering at least three fourths of the total crown.

Nery *et al* (1995) (26) graded using the modified Angelopoulos and Goaz method. The index is discussed in Table 10.

Table 10 Nery index

Subjects with natural teeth		Edentulous subjects	
0	No gingival overgrowth.	0	No growth at any location.
1	Light gingival overgrowth at the cervical third and/or interproximal area of the anatomic crown, localized or generalized.	1	One or two areas of soft tissue overgrowth.
2	Moderate gingival overgrowth that covers the cervical third and interproximal areas, localized or generalized.	2	Three or four areas of soft tissue overgrowth.
3	Severe gingival overgrowth that covers the cervical two-thirds and interproximal areas, localized or generalized.	3	Five to six areas of soft tissue overgrowth (generalized).

Fu *et al* (1995) (27) investigated the sequence of gingival alterations over time in stone casts with a Boley gauge, to the nearest millimeter, and included the buccolingual width, the mesiodistal width, and the vertical height of the gingiva (distance from the incisal aspect of the central papilla to the mucogingival junction).

O' Valle *et al* (1995) (28) classified gingival enlargement (Table 11) based on digital image analysis of photographs and modifications by Pernu *et al*. Additionally, the areas of interest were delineated as "gingival area" the surface between the mucogingival line and the free margin of the gingiva, "dental area" the vestibular surface of the incisors not covered by the gums and "papillary area" was the free gingival surface between the incisors. The overgrowth index (GOI) for each subject was obtained by dividing "gingival area" by "dental area".

Table 11 O'Valle index

SCORE	FEATURES
0	No gingival overgrowth
1	Mild gingival overgrowth (thickening of the marginal gingiva and/or lobular granulation of the gingival pocket as well as overgrowth covering the gingival third of the crown or less.
2	Moderate gingival overgrowth (overgrowth extending to the middle of the crown).
3	Severe gingival overgrowth (overgrowth covering two thirds of the crown or affection of the whole attached gingiva).

Miranda and Brunet (1998) (29) measured gingival enlargement in the buccal-lingual direction in all interdental papilla according to the index described by Seymour *et al* and modified by Miranda *et al*. (nodullary papilla index) (Table 12).

Table 12 MB index/ nodullary papilla index

GRADE	FEATURE
0	Papillary thickness of less than 1 mm
1	Papillary thickness between 1 and 2 mm
2	Papillary thickness greater than 2 mm

Ingles (1999) (30) classified gingival enlargement as follows (Table 13):

Table 13 Ingles index

GRADE	FEATURES
0	No overgrowth; firm adaptation of the attached gingiva to the underlying alveolar bone. There is slight stippling; there is no granular appearance or a slightly granular appearance. A knife-edged papilla is present toward the occlusal surface. There is no increase in density or size of the gingiva
1	Early overgrowth, as evidenced by an increase in density of the gingiva with marked stippling and granular appearance. The tip of the papilla is rounded. The probing depth is less than or equal to 3 mm.
2	Moderate overgrowth, manifested by an increase in the size of the papilla and/or rolled gingival margins. The contour of the gingival margin is still concave or straight. Gingival enlargement has a buccolingual dimension of up to 2 mm, measured from the tip of the papilla outward. The probing depth is equal to or less than 6 mm. The papilla is somewhat retractable.
3	Marked overgrowth, represented by encroachment of the gingiva onto the clinical crown. The contour of the gingival margin is convex rather than concave. Gingival enlargement has a buccolingual dimension of approximately 3 mm or more, measured from the tip of the papilla outward. The probing depth is greater than 6 mm. The papilla is clearly retractable.
4	Severe overgrowth, characterized by a profound thickening of the gingiva. A large percentage of the clinical crown is covered. Same as for grade 3: The papilla is retractable; the probing depth is greater than 6 mm, and the buccolingual dimension is approximately 3 mm.

Ellis and Seymour (2001) (31) calculated gingival overgrowth by projecting the slides onto a screen and assessed and scored anterior papillae for overgrowth using the vertical component of the described technique according to the same criteria (Seymour *et al*. 1985).

Rosin (JCP 2002) (32) scanned the buccal side of the replicas, 2 each with a 3-D laser scanner. Volume quantification was performed with the help of software integrated in the scanner to superimpose the 3-D data sets from the given pairs of replicas and calculate a difference image.

Thomason (2005) (33) proposed an objective evaluation method for the measurement of changes in gingival contour. It was carried out by computer models of a sequence of replicas of the study surface in all the three dimensions. Ultimately, it yielded a volumetric analysis of enlargement.

To summarize the literature regarding indices methods to record and assess gingival enlargement, I would like to conclude the present article with a summary table (Table 14) of all the available indices in my knowledge, which segregates them based upon the planes they were proposed.

Table 14 Summary table of present indices

Miscellaneous	Vertical plane	Both horizontal and vertical plane	Volumetric
	Ingle (1959)		
	Aas (1963)		
Kimball (1939)	Angelopoulos and		
Robinson (1942)	Goaz (1972)	Seymour (1985)	
Harris and Ewalt (1942)	Conard (1974)	Dahllof G and Hassell (1984)	
Barak (1987)	Daley et al (1986)	Modder T (1986)	O' Valle (1995)
Heijl and Sundin (1988)	Friskopp (1986)	King (1993)	Rosin (2002)
Hefi (1994)	McGaw (1987)	Fu (1995)	Thomason (2005)
Somacarrera (1994)	Drew (1987)	Miranda and Brunet (1998)	
	Nery (1995)	Ingles (1999)	
	Pasqualin (1990)		
	Kitamura (1990)		
	Miller and Damm (1992)		

CONCLUSION

Recording a gingival overgrowth before treating it is inevitable in nature. A thorough knowledge of various indices present in the literature is a must for any clinician who confronts gingival enlargement in their clinical practice. Formulating a treatment plan and treating the case will become predictable by applying these indices.

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