



SPOTLIGHT ON

Soft Tissue Phenotype

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[@gumsandroses](https://www.instagram.com/gumsandroses)



Learning Objectives

- Identify the components of periodontal and peri-implant phenotype.
- Understand the impact of tissue phenotype on periodontal and peri-implant health.
- Discuss evidence-based indications and considerations for phenotype modification surgeries.



A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification

Mucogingival deformities and conditions around teeth

- a. Gingival phenotype
- b. Gingival/soft tissue recession
- c. Lack of gingiva
- d. Decreased vestibular depth
- e. Aberrant frenum/muscle position
- f. Gingival excess
- g. Abnormal color
- h. Condition of the exposed root surface

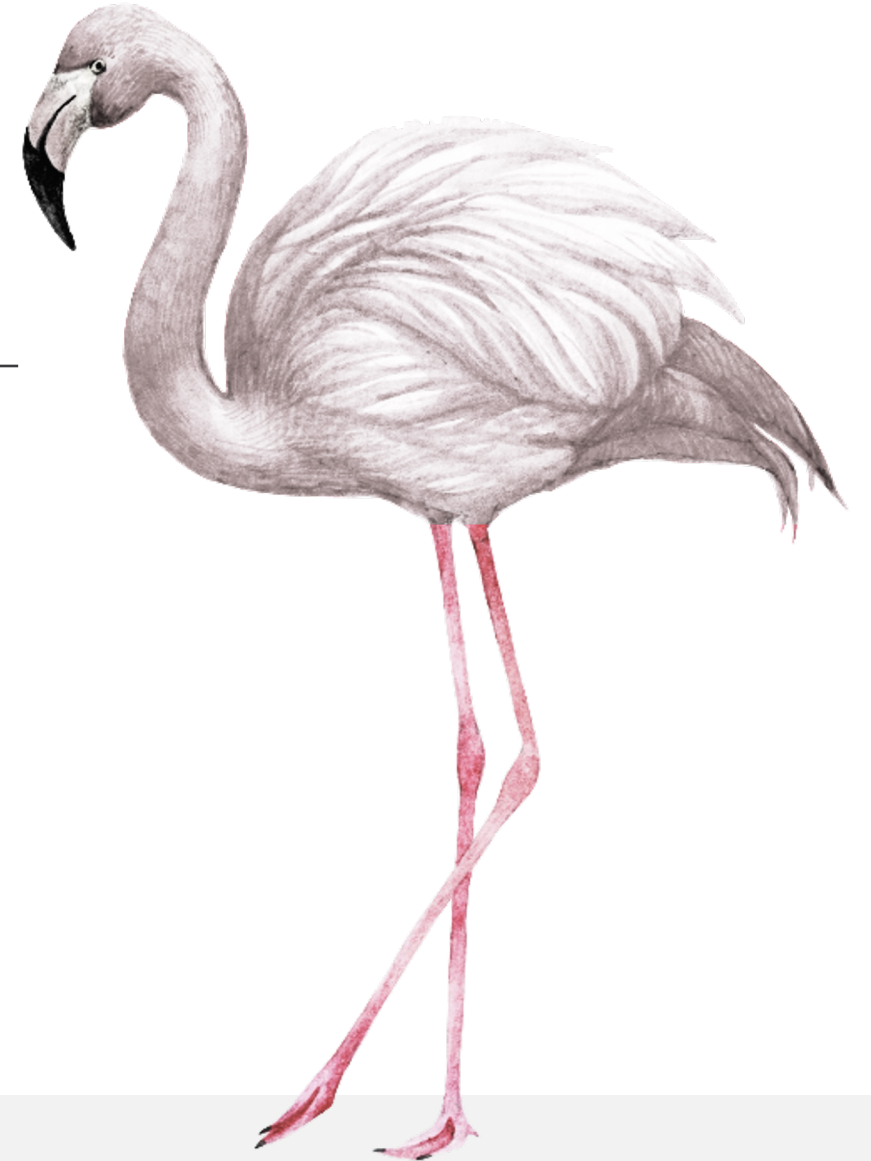
In the consensus report the term *biotype* was replaced by *phenotype*

Phenotype

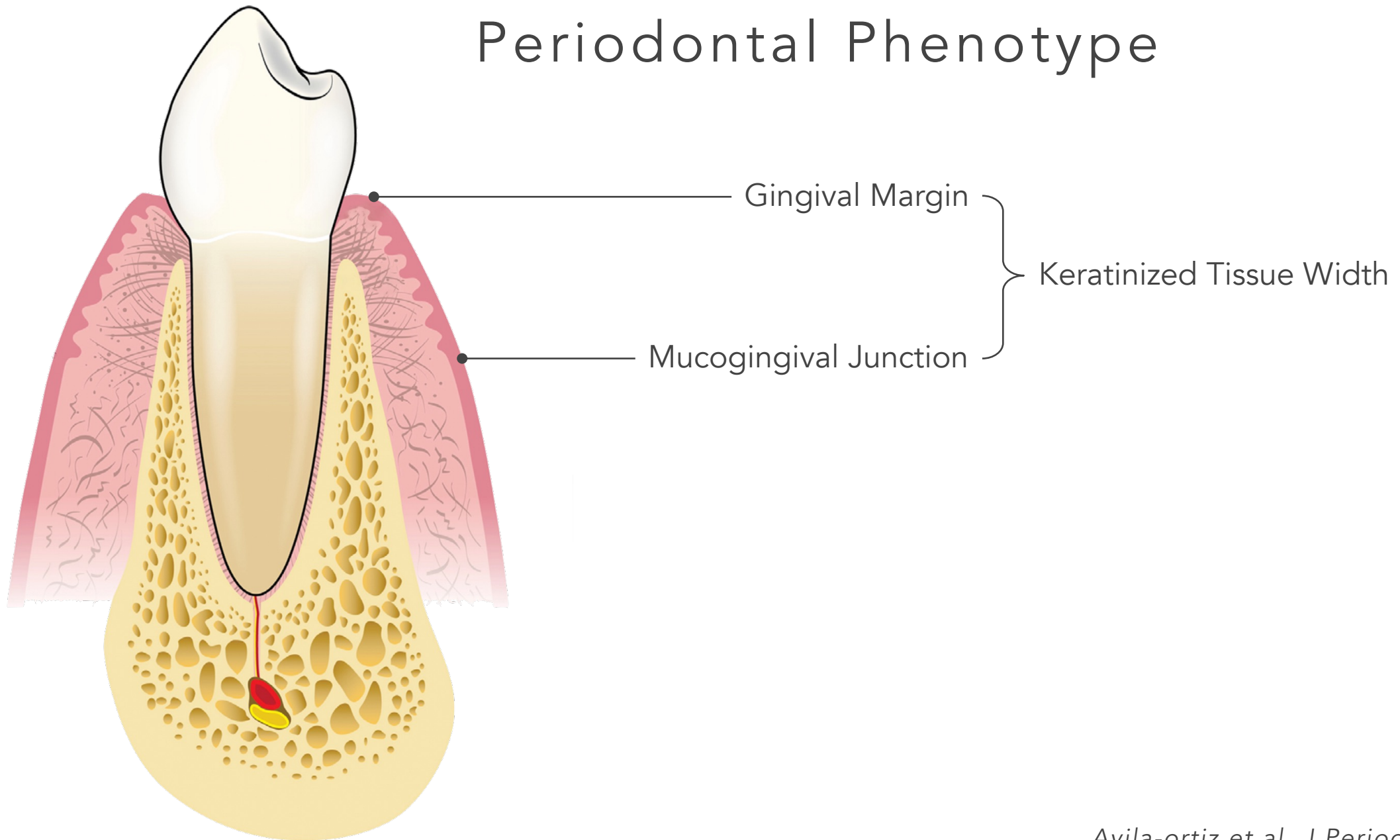
[phe·no·type] *noun*

the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment.

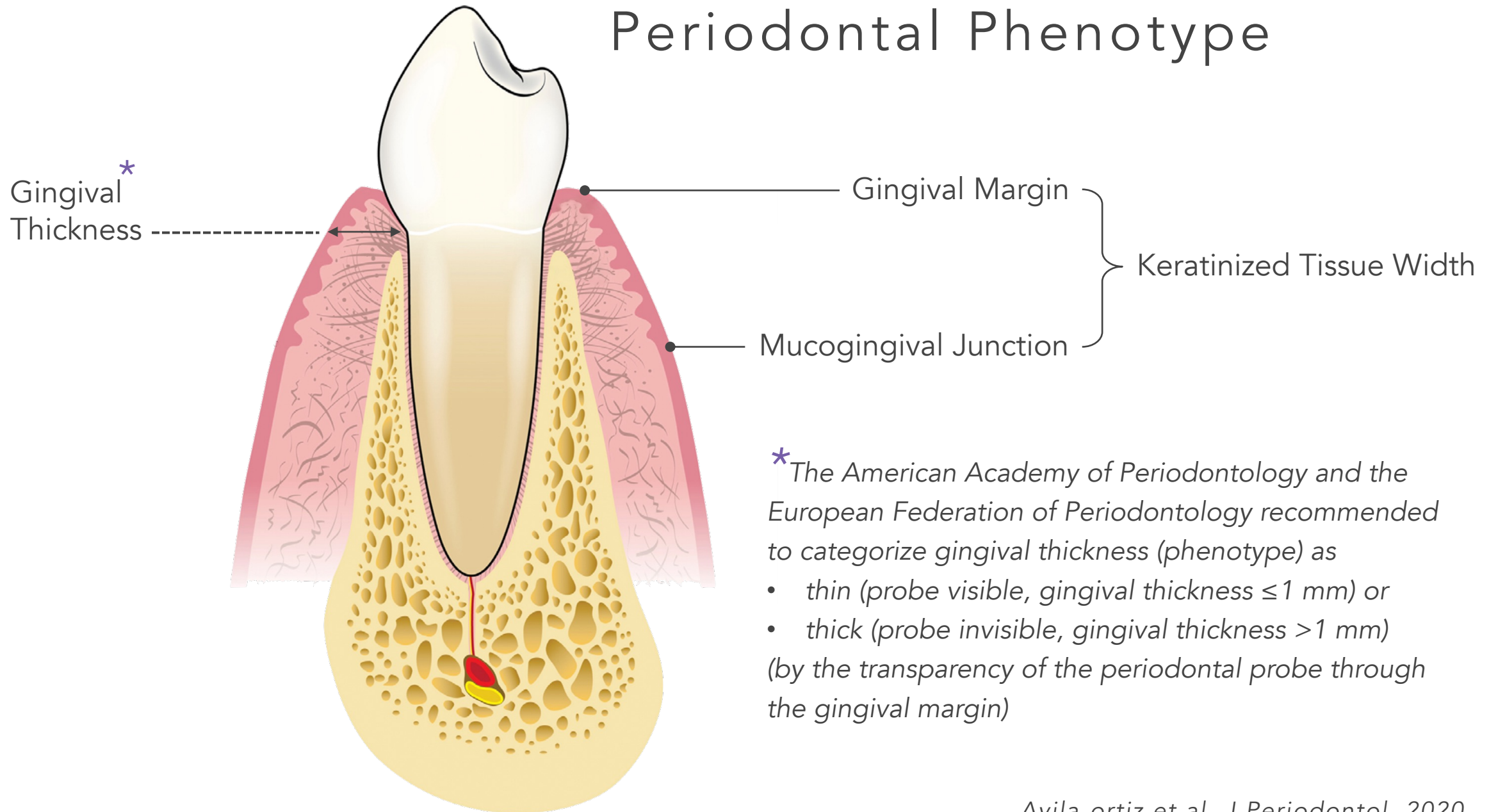
the term "phenotype" should not be used interchangeably with "biotype," which refers to a set of organisms that share a specific genotype.



Periodontal Phenotype



Periodontal Phenotype





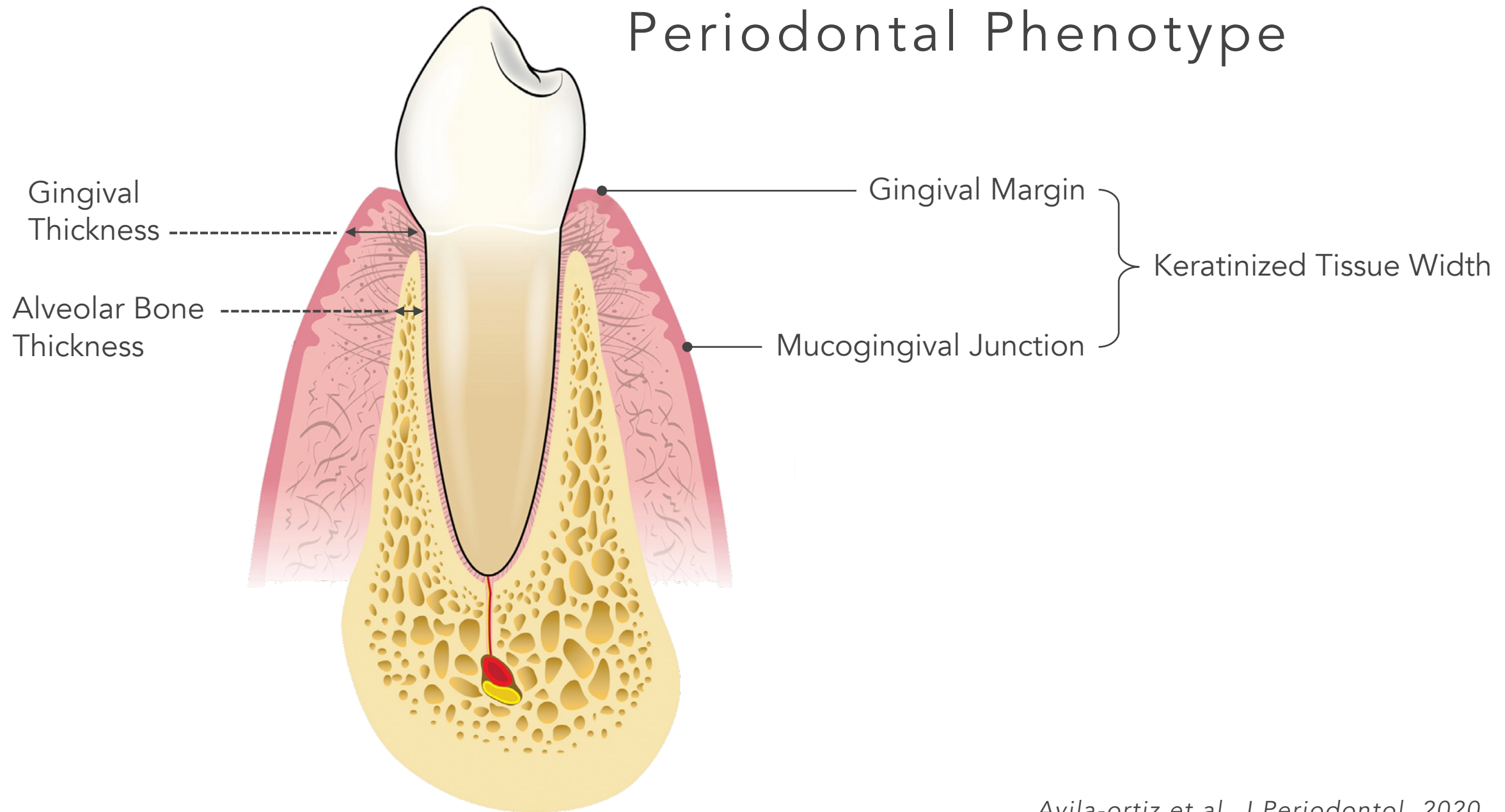
Thin Phenotype
(probe visible, gingival thickness ≤ 1 mm)

Thick Phenotype

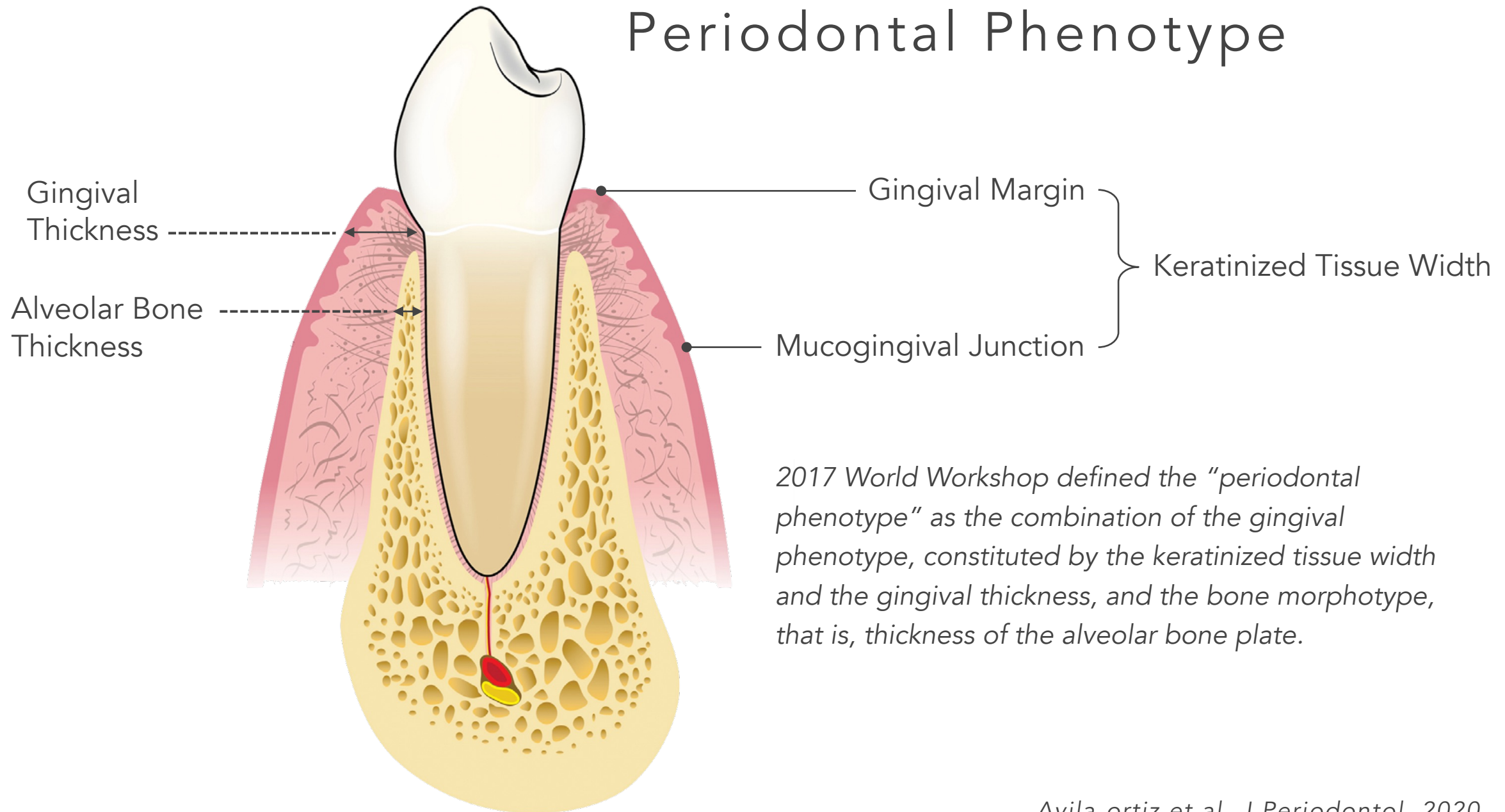
(probe visible, gingival thickness >1 mm)



Periodontal Phenotype



Periodontal Phenotype



2017 World Workshop defined the “periodontal phenotype” as the combination of the gingival phenotype, constituted by the keratinized tissue width and the gingival thickness, and the bone morphotype, that is, thickness of the alveolar bone plate.

Periodontal Soft Tissue Phenotype

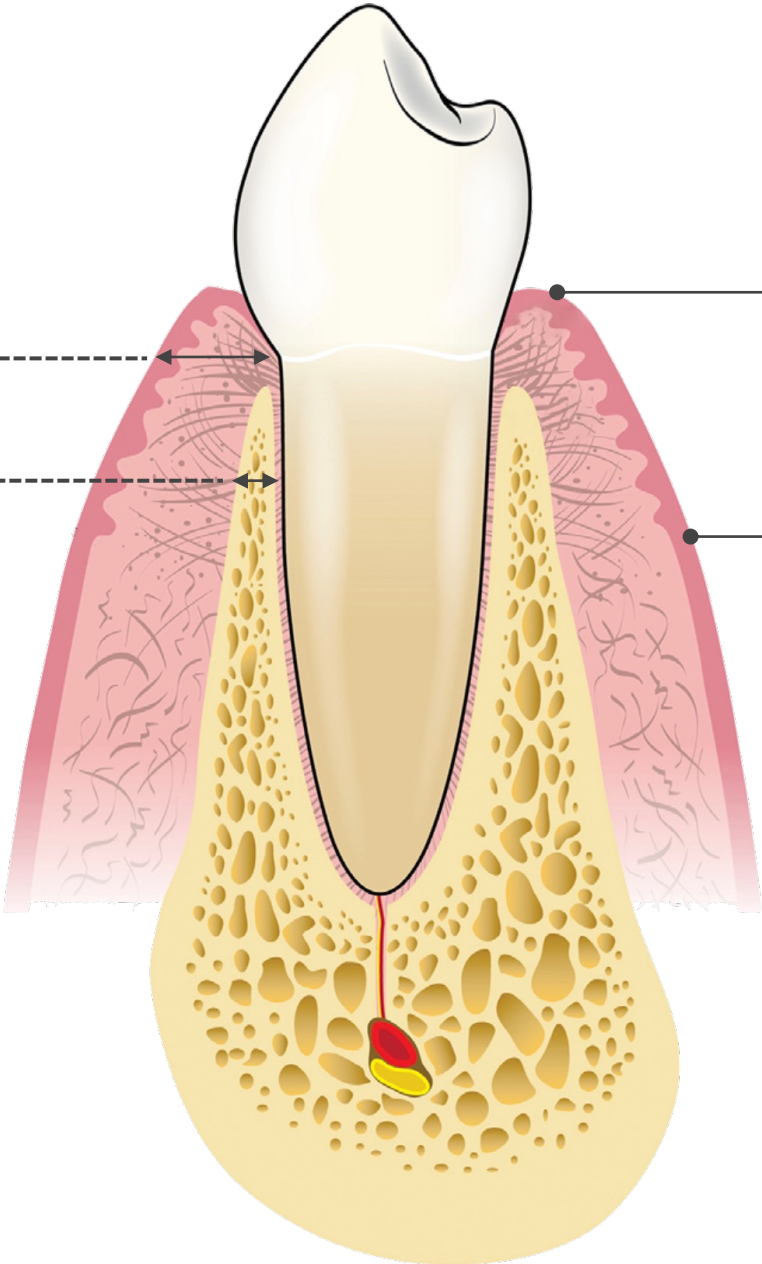
Gingival Thickness

Alveolar Bone Thickness

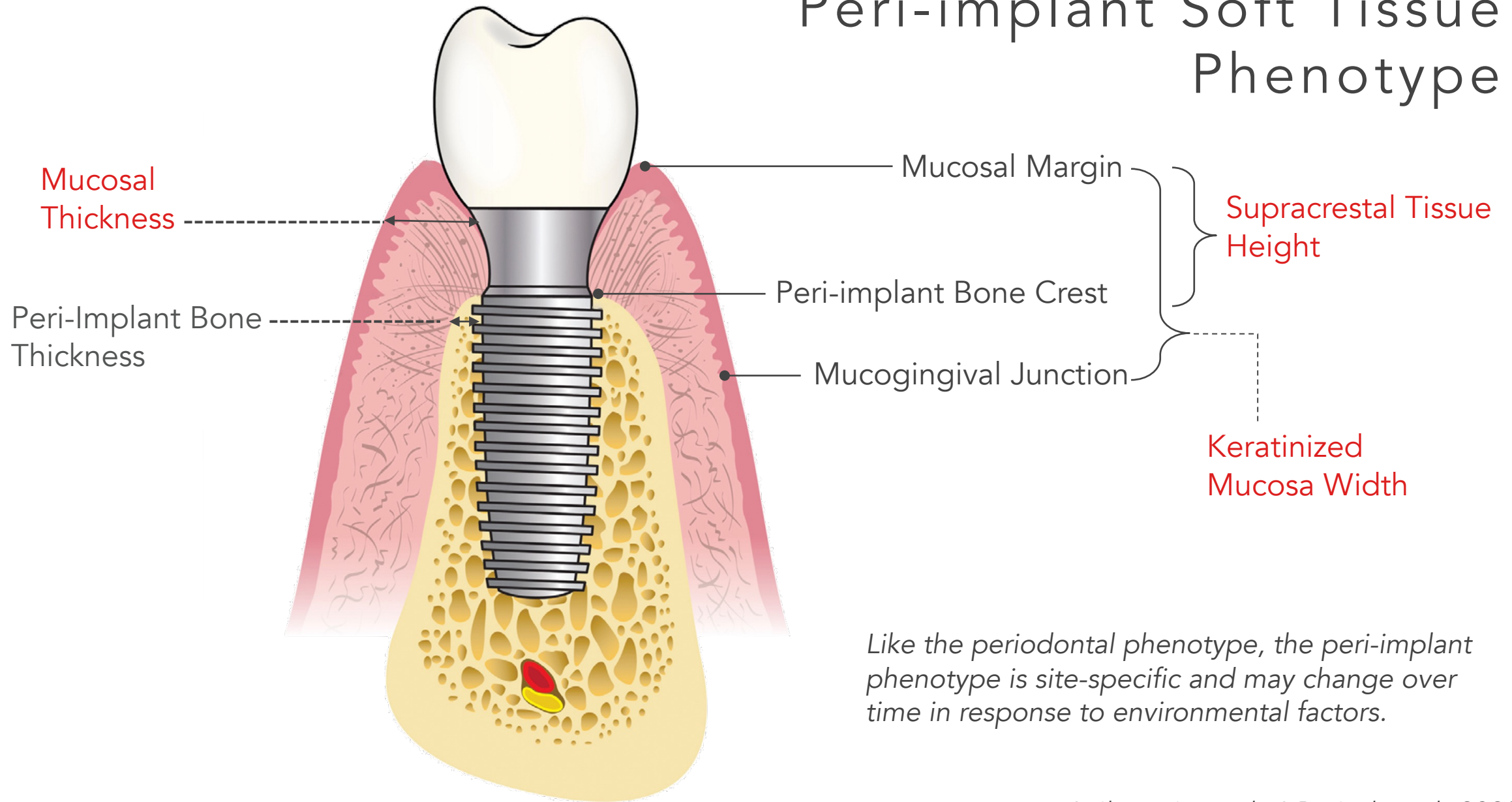
Gingival Margin

Mucogingival Junction

Keratinized Tissue Width



Peri-implant Soft Tissue Phenotype



Like the periodontal phenotype, the peri-implant phenotype is site-specific and may change over time in response to environmental factors.

Phenotype Modification Therapy

Recent advances in surgical interventions now permit the modification of the masticatory complex, including keratinized tissue/mucosa width, connective tissue thickness, and bone morphotype.

These surgical interventions to improve the dimensions of soft tissue, bone, or both are collectively referred to as Phenotype Modification Therapy (PhMT).



Frequently
Asked
Questions



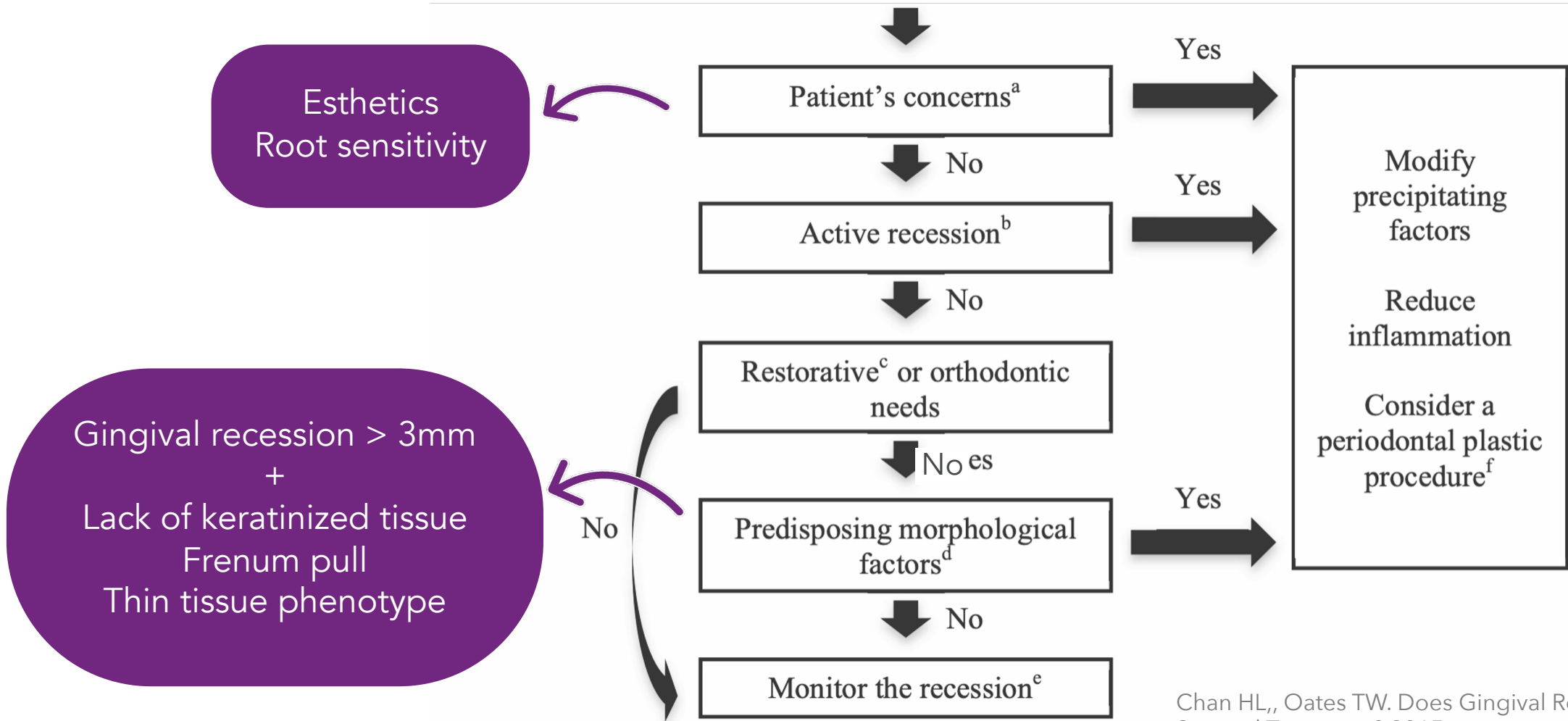
Anuja Doshi

1

When should we
treat/refer a
patient with
Gingival
Recession?



When should we treat Gingival Recession?



Chan HL,, Oates TW. Does Gingival Recession Require Surgical Treatment? 2015

What is the best evidence consensus on treatment of Gingival Recession?



- Autogenous Connective Tissue Graft (CTG) with a Coronally Advanced Flap is still considered as “gold standard” procedure for the treatment of single and multiple gingival recession when the treatment goal is root coverage + clinical attachment again.
- Acellular Dermal Matrix Graft (primarily) and Xenogenic Collagen Matrix (secondly) may be considered as alternative soft tissue grafting materials.

What happens if gingival recessions are left untreated?



- Consistent evidence that untreated buccal gingival recession (GR) defects in individuals with good oral hygiene are highly likely (78% of defects) to progress.
- In general, the preexisting amount of Keratinized tissue seems to influence the development and progression of GR during follow-up, with sites lacking KT seemingly more susceptible to further CAL loss.
- Increased risk for root caries.

2

What is the consensus on treatment of Lack of Keratinized Tissue Width?



What is the consensus on treatment of lack of keratinized tissue width?



- The 2015 American Academy of Periodontology Regeneration Workshop concluded that there is no threshold amount of KTW that is required around teeth in the presence of optimal plaque control.
- However, in the presence of an inadequate plaque control, $KTW \geq 2$ mm appears to be beneficial for preventing progressive attachment loss.

- Free Gingival Graft (FGG) stands true as the gold standard treatment for increasing Keratinized Tissue + Deepening vestibule.
- In 18- to 35-year long-term study, Agudio et al. corroborated the efficacy of FGG in maintaining the stability of the soft tissue, observing a tendency for the coronal migration of the gingival margin as well (creeping attachment).
- Similarly, the untreated sites were found to be prone for an increase in their existing recessions or developing new ones.



3

Phenotype
Modification
Therapy beneficial
for Orthodontic
Patients?



Phenotype Modification beneficial for patients receiving Orthodontic treatment?

- It has been documented that about 25% of patients may develop facial gingival recession 2 to 5 years after orthodontic treatment.
- Recent literature indicates a higher incidence of bony dehiscence and recession in teeth exhibiting a thin periodontal phenotype
- And in teeth exposed to orthodontic forces intended to move the dentition outside of the alveolar housing, such as arch expansion.

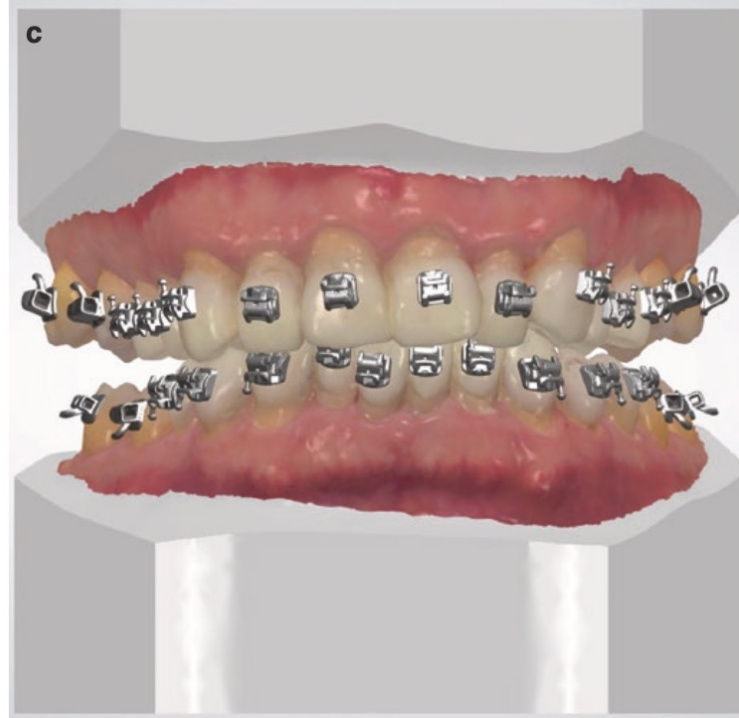


Best evidence consensus: modifying periodontal phenotype in preparation for orthodontic and restorative treatment. J Periodontol 2019





Bone Phenotype Modification



Surgically Facilitated Orthodontic Therapy: An Interdisciplinary Approach

- Phenotype modification via corticotomy-assisted orthodontic therapy (CAOT) combined with simultaneous bone augmentation (also termed **surgically facilitated orthodontics**) may provide clinical benefits to patients undergoing orthodontic treatment.
- Bone PhMT should be pursued prior to orthodontic treatment in patients with thin phenotype when the necessary orthodontic tooth movement will compromise the bony housing.





A

*Does
Phenotype
Modification Therapy
contribute to
maintaining
Periodontal Health?*

Does Phenotype Modification Therapy contribute to maintaining Periodontal Health?

- Recent systematic review concluded that subjects with thin gingival phenotype tend to have more gingival recession than those with thick.
- However, Periodontal health can be maintained in sites exhibiting a thin tissue phenotype, provided good oral hygiene is performed and iatrogenic factors (restorative/orthodontics) are absent.
- Currently, there is no published evidence to support that modification of thin to thick gingival phenotype will maintain periodontal health in sites without gingival recession or mucogingival deformity.



REVIEW

Gingival phenotype modification therapies on natural teeth: A network meta-analysis

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Abstract

Background: The periodontal phenotype consists of the bone morphotype, the keratinized tissue (KT), and gingival thickness (GT). The latter two components, overlying the bone, constitute the gingival phenotype. Several techniques have been proposed for enhancing or augmenting KT or GT. However, how phenotype modification therapy (PMT) affects periodontal health and whether the obtained outcomes are maintained over time have not been elucidated. The aim of the present review was to summarize the available evidence in regard to the utilized approaches for gingival PMT and assess their comparative efficacy in augmenting KT, GT and in improving periodontal health using autogenous, allogenic, and xenogeneic grafting approaches.

Methods: A detailed systematic search was performed to identify eligible randomized clinical trials (RCTs) reporting on the changes in GT and KT (primary outcomes). The selected articles were segregated into the type of approach based on having performed a root coverage, or non-root coverage procedure. A network meta-analysis (NMA) was conducted for each approach to assess and compare the outcomes among different treatment arms for the primary outcomes.

Results: A total of 105 eligible RCTs were included. 95 pertaining to root coverage (3,539 treated gingival recessions [GRs]), and 10 for non-root coverage procedures (699 total treated sites). The analysis on root coverage procedures showed that all investigated techniques (the acellular dermal matrix [ADM], collagen matrix [CM], connective tissue graft [CTG]) are able to significantly increase the GT, compared with treatment with flap alone. However, KT was only significantly increased with the use of CTG or ADM. Early post-treatment GT was found to inversely predict future GR. For non-root coverage procedures, only the changes in KT could be analyzed; all investigated treatment groups (ADM, CM, free gingival graft [FGG], living cellular construct [LCC], in combination with an apically positioned flap [APF]), resulted in significantly more KT than treatment with APF alone. Additionally, the augmented GT was shown to be sustained, and KT displayed an incremental increase over time.

- Phenotype Modification by using autogenous grafts or substitutes has been shown to effectively increase the GT.
- The [GT gained after soft tissue surgery can act as a predictor of gingival margin stability over time.](#)
A thickened gingival margin can protect from the trauma of toothbrushing, but can also result in the coronal migration of the gingival margin over time.
- FGG is the only gingival augmentation treatment that had a tendency for recession reduction over time.

Phenotype Modification Therapy and Long term Periodontal Health

- Gingival phenotype modification at the short term predicts the long-term stability of the gingival margin over 10 years.
- In the presence of at least 1.5 mm of KTW, achieving a GT of 1.46 mm at 6 months after procedure was the key determining site characteristic for a stable gingival margin in the long term





Effect of gingival augmentation procedure (free gingival graft) on reducing the risk of non-carious cervical lesions: A 25- to 30-year follow-up study

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Abstract

Background: The aim of this long-term case series was to assess the development/prevalence of non-carious cervical lesions (NCCLs) at sites that have and have not been treated with gingival augmentation following free gingival graft (FGG).

Methods: Fifty-two patients had at least one test and one control site: 1) test site showing absence of attached gingiva (AG) associated with gingival recession (GR) treated with FGG; and 2) contralateral site with or without AG. Patient/tooth/site-associated variables were recorded for each tooth/site at baseline (T0), 12 months after surgery (T1), during the follow-up period (T2) (15 to 20 years), and at the end of the follow-up period (T3) over 25 to 30 years. Mixed-effects logistic regression was used throughout the study.

Results: Forty-nine patients/130 sites were available for analysis at T2 whereas 44 patients/120 sites at T3. Twenty-two NCCLs >0.5 mm were restored in the test sites and in 35 in the untreated sites. The development of NCCL over time appeared associated with sites with attached KT <2 mm (i.e., odds ratio [OR]: 3.80 [$P = 0.045$] and 3.47 [$P = 0.046$], 15- to 20- and 20- to 30-year follow-ups, respectively), as well as to teeth presenting a thin/non-modified periodontal phenotype (i.e., OR: 3.53 [$P = 0.037$] and 5.51 [$P = 0.008$], 15- to 20- and 20- to 30-year follow-ups, respectively).

Conclusions: Periodontal phenotype modification achieved by FGG may prevent the development/progression of NCCL. Evidence suggests that the thickness and width of the AG had a direct influence on the need of restoring these lesions during the 25- to 30-year observation period.

KEYWORDS

gingiva, gingival recession, oral surgical procedures, tooth root, transplants

Conclusions: Periodontal phenotype modification achieved by FGG may prevent the development/progression of NCCL. Evidence suggests that the thickness and width of the AG had a direct influence on the need of restoring these lesions during the 25- to 30-year observation period.

Importance of
Periodontal Phenotype
for Tooth Health



Importance of *Periodontal Tissue Phenotype* for Tooth Health

- Probing depths are greater in patients with thick gingival phenotype.
- Patients with thin tissue and narrow gingival width tend to have a higher incidence of gingival recession.
- Periodontal health can be maintained in sites exhibiting a thin gingival phenotype, provided good oral hygiene is performed and iatrogenic factors are absent.

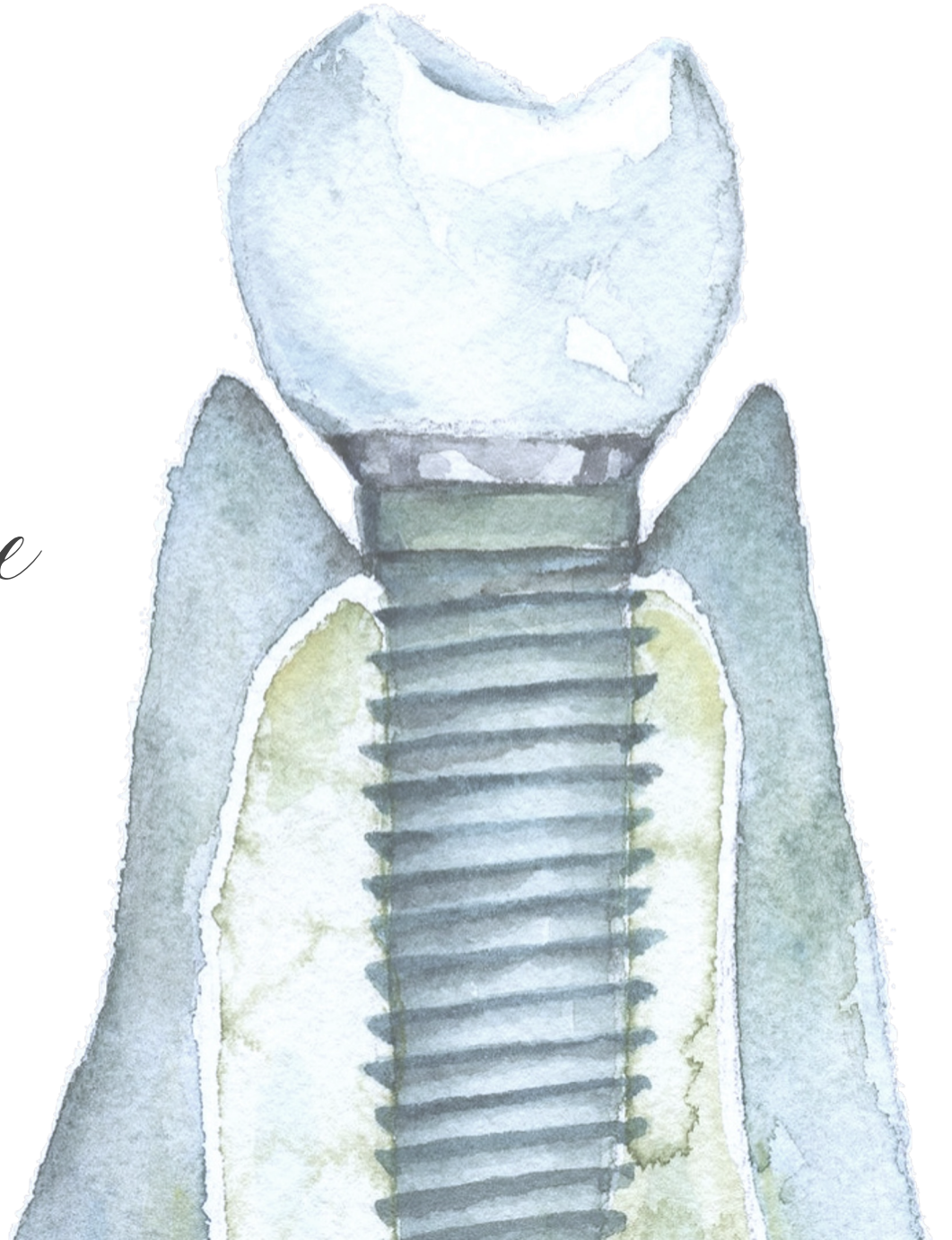


Importance of *Periodontal Tissue Phenotype* for Tooth health

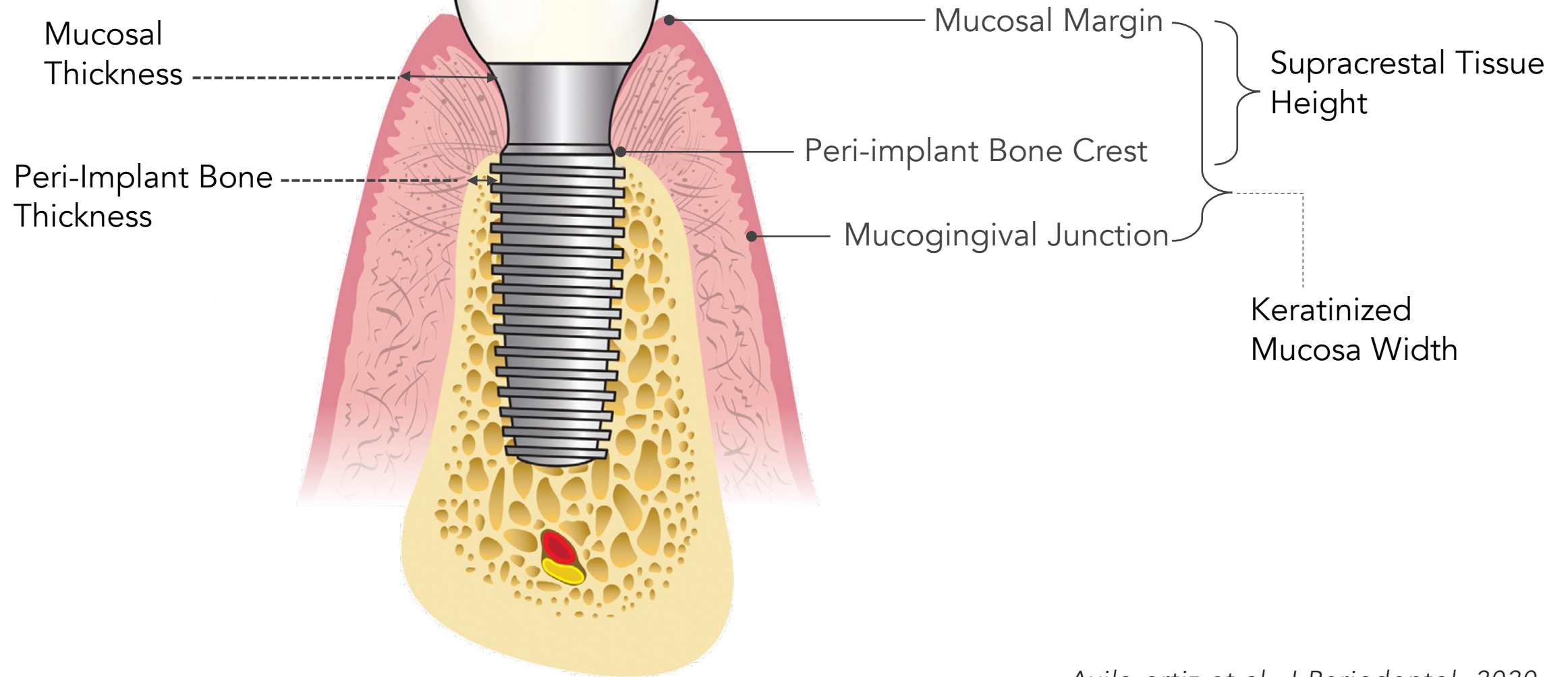
- Any amount of keratinized gingiva is enough to maintain periodontal health in the presence of optimal oral hygiene.
- Sites with mucogingival defects and soft tissue thickness < 1 mm would benefit from PhMT intervention and may require a secondary procedure to achieve optimal outcomes.
- Sites exhibiting soft tissue thickness ≥ 1 mm are associated with more predictable mucogingival surgery outcomes, as compared with thin phenotype.



Importance of
Peri-Implant Phenotype
for Implant Health



Peri-implant Phenotype



Clinical relevance of inadequate Keratinized Mucosa Width and Mucosal Thickness

- 2017 World Workshop concluded, the evidence is equivocal regarding the effect that the presence or absence of keratinized mucosa has on the long-term health of the peri-implant tissues.
- However, there is increasing amount of high-level evidence that associates inadequate KMW (<2 mm) with peri-implant mucositis.
- A recent study found that a minimum amount of 2 mm of KMW was critical to minimize the incidence of peri-implant mucositis and future marginal bone loss in erratic maintenance compliers.

Importance of keratinized mucosa around dental implants: Consensus report of group 1 of the DGI/SEPA/Osteology Workshop

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Andrés Pascual⁷  | Ausra Ramanauskaite² | Franck Renouard⁸ | Robert Sader² |
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Abstract

Objectives: To assess the literature on (i) the relevance of the presence of a minimum dimension of keratinized peri-implant mucosa (KPIM) to maintain the health and stability of peri-implant tissues, and; (ii) the surgical interventions and grafting materials used for augmenting the dimensions of the KPIM when there is a minimal amount or absence of it.

Material & Methods: Two systematic reviews complemented by expert opinion from workshop group participants served as the basis of the consensus statements, implications for clinical practice and future research, and were approved in plenary session by all workshop participants.

Results: Thirty-four consensus statements, eight implications for clinical practice, and 13 implications for future research were discussed and agreed upon. There is no consistent data on the incidence of peri-implant mucositis relative to the presence or absence of KPIM. However, reduced KPIM width is associated with increased biofilm accumulation, soft-tissue inflammation, greater patient discomfort, mucosal



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Results: Thirty-four consensus statements, eight implications for clinical practice, and 13 implications for future research were discussed and agreed upon. There is no consistent data on the incidence of peri-implant mucositis relative to the presence or absence of KPIM. However, reduced KPIM width is associated with increased biofilm accumulation, soft-tissue inflammation, greater patient discomfort, mucosal recession, marginal bone loss and an increased prevalence of peri-implantitis. Free gingival autogenous grafts were considered the standard of care surgical intervention to effectively increase the width of KPIM. However, substitutes of xenogeneic origin may be an alternative to autogenous tissues, since similar results when compared to connective tissue grafts were reported.

What sites lacking KMW should be recommended for Phenotype Modification Therapy?

When there is <2 mm of KMW Phenotype Modification could be considered especially when there is:

- ✓ Recurrent inflammation of the peri-implant mucosa
- ✓ Pain or disturbance on brushing
- ✓ Increased recession of the peri-implant mucosa
- ✓ Lack of attached mucosa or a shallow vestibular depth that interferes with plaque control
- ✓ Erratic compliers



5

*Does
Phenotype
Modification Therapy
contribute to
maintaining
Peri-implant
Health?*



Phenotype Modification Therapy and long term Peri-implant health

- Increased keratinized mucosa via soft tissue grafting is associated with a significant reduction in probing depth, soft tissue dehiscence, plaque index and improvement in aesthetics regardless of the soft tissue grafting material employed.
- Current long- term (12 years) clinical studies have shown stable and healthy keratinized peri-implant soft tissue even in the case of missing buccal bone at implant sites.






Phenotype Modification Therapy and long term Peri-implant health



REVIEW ARTICLE

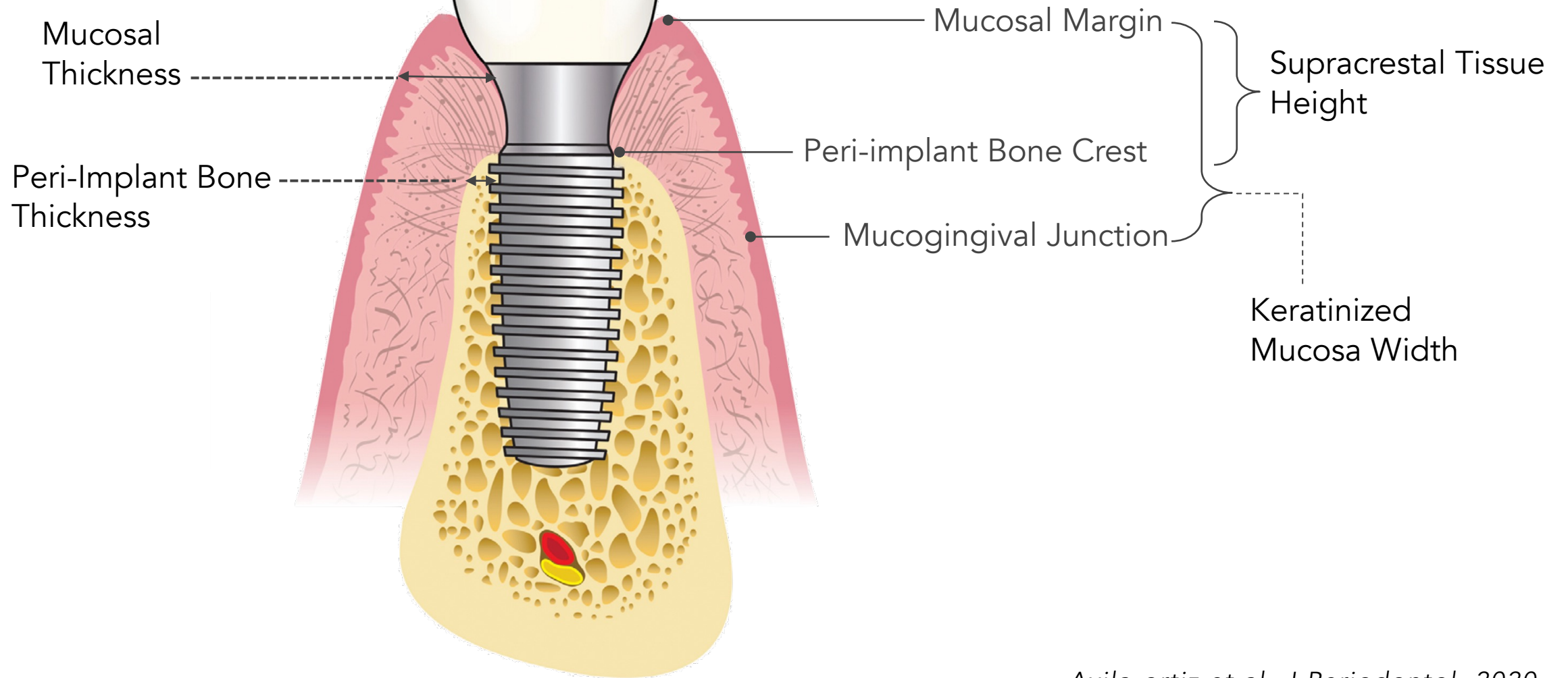
WILEY CLINICAL ORAL IMPLANTS RESEARCH

Effects of soft tissue augmentation procedures on peri-implant health or disease: A systematic review and meta-analysis

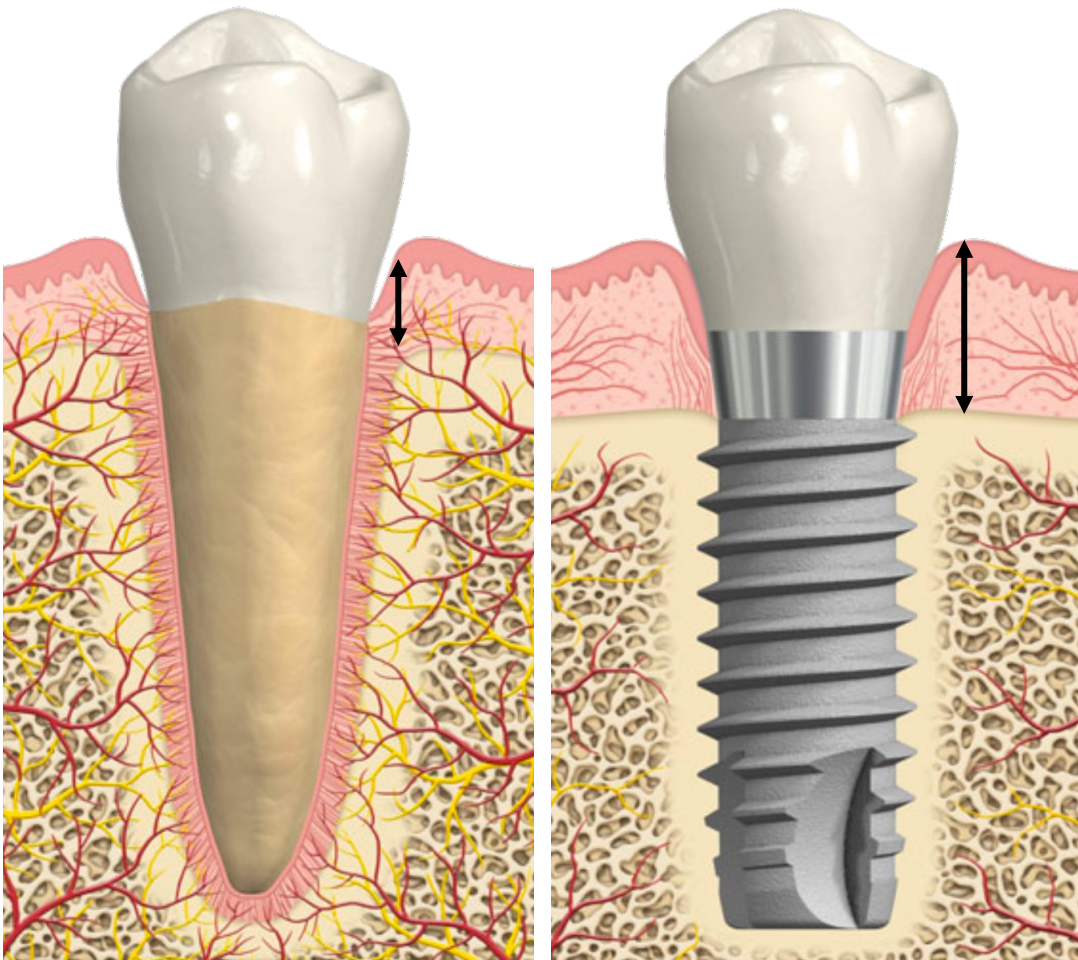
Daniel S. Thoma¹  | Nadja Naenni¹  | Elena Figuero^{2,3} | Christoph H. F. Hämmerle¹ | Frank Schwarz^{4,5} | Ronald E. Jung¹  | Ignacio Sanz-Sánchez^{2,3}

Soft tissue grafting procedures for gain of mucosal thickness resulted in significantly less marginal bone loss over time.

Peri-implant Phenotype



Periodontal vs Peri-implant

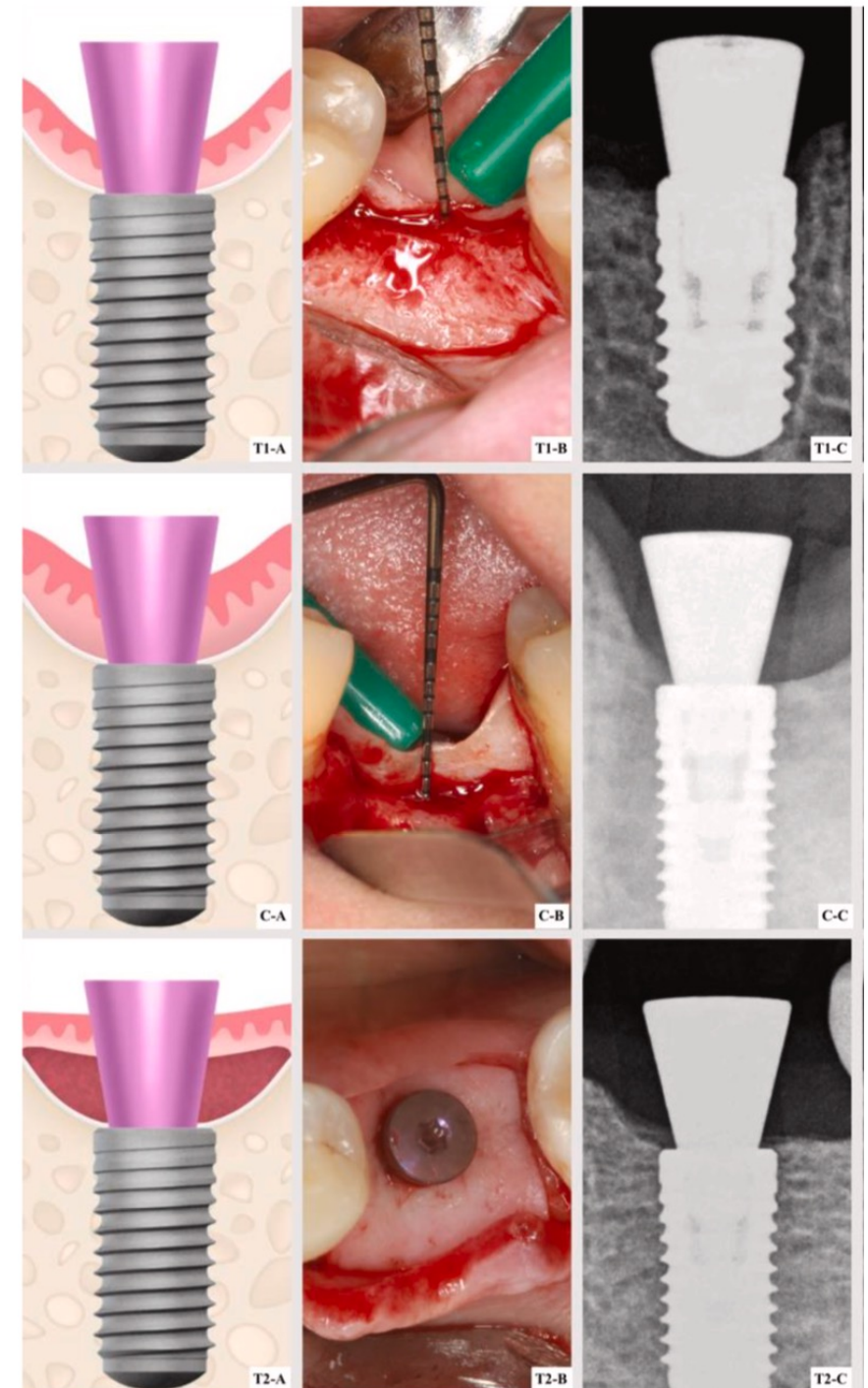


- STH should not be used interchangeably with the analogous term “supracrestal tissue attachment,” which only applies to natural teeth, and that has recently replaced the classic term “biologic width.”
- The peri-implant STH encompasses the sulcular epithelium, the junctional epithelium, and the supracrestal connective tissue, which is typically not attached to the abutment surface.
- STH is usually taller than the supracrestal tissue attachment around teeth to an average magnitude of an additional 1.0 to 1.5 mm

Clinical relevance of Supracrestal Tissue Height

- This long-term study suggests the effectiveness of thick or surgically thickened soft tissue height around implants maintaining crestal bone levels.
- A significant improvement in bone levels around implants was observed in the group with STH (> 2 mm) during the 10 years follow-up period.
- However, a trend towards bone loss was identified in the thin tissue height group (≤ 2 mm).

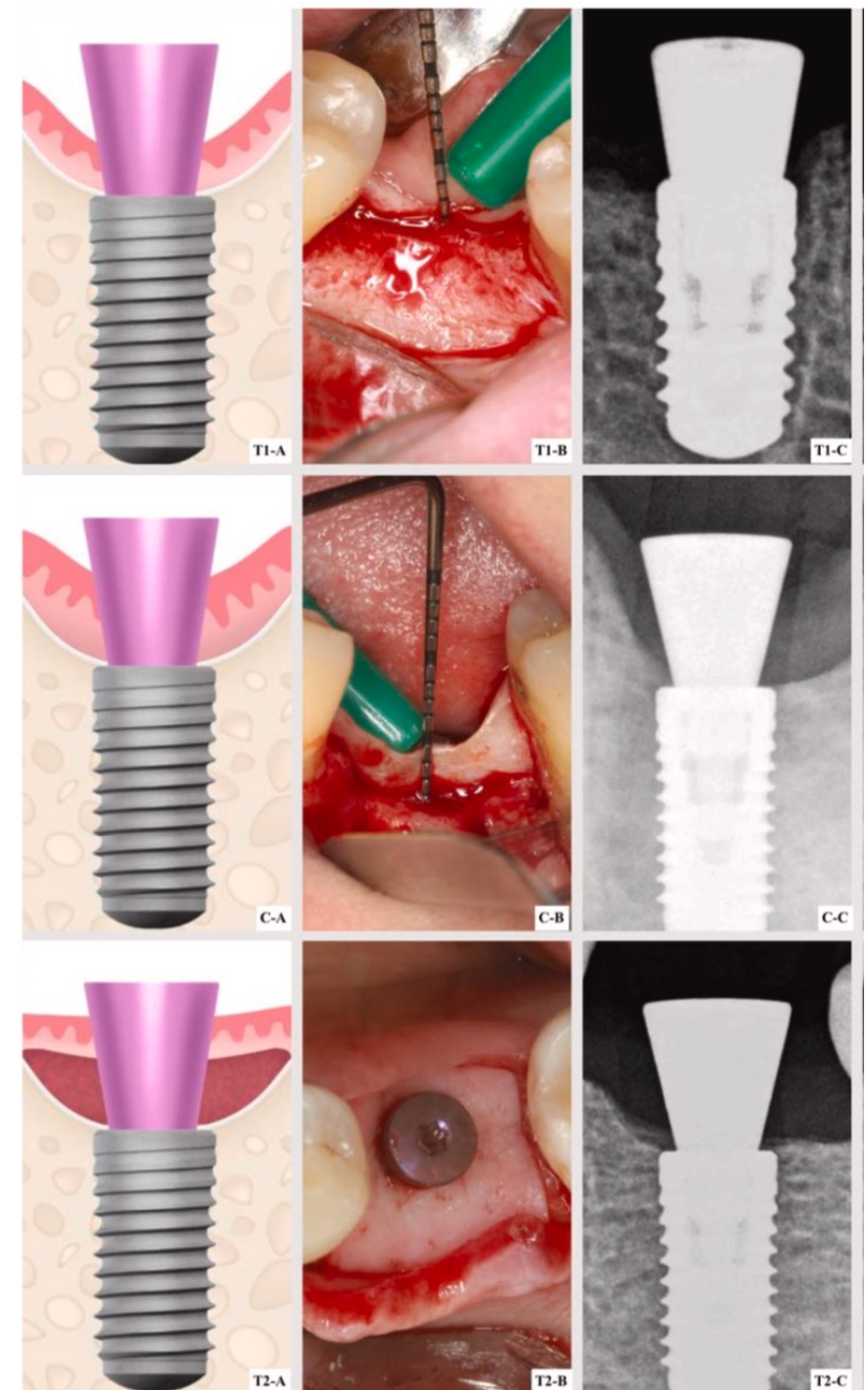
A. Puisys et al. Journal of Dentistry



Clinical relevance of Supracrestal Tissue Height

- The available evidence is quite robust in this area. According to the findings reported in multiple clinical studies the STH plays a critical role in marginal bone loss patterns.
- Short STH at the time of implant placement has been consistently associated with a variable amount of marginal bone loss.
- Current evidence indicates that this concept applies independently of the implant design (e.g., bone versus soft tissue level implant) and the restorative modality (platform switching).

Avila-ortiz et al. J Periodontol. 2020

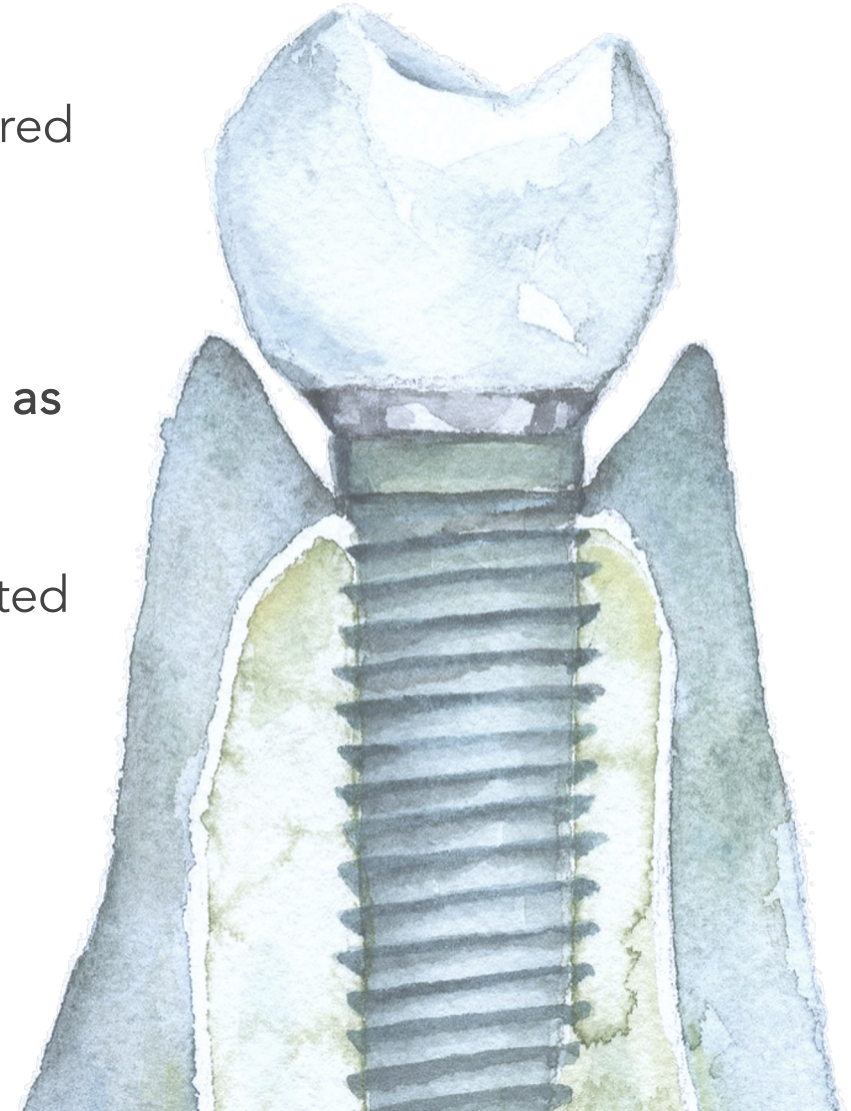


The Importance of
Peri-implant Phenotype
for Implant Health



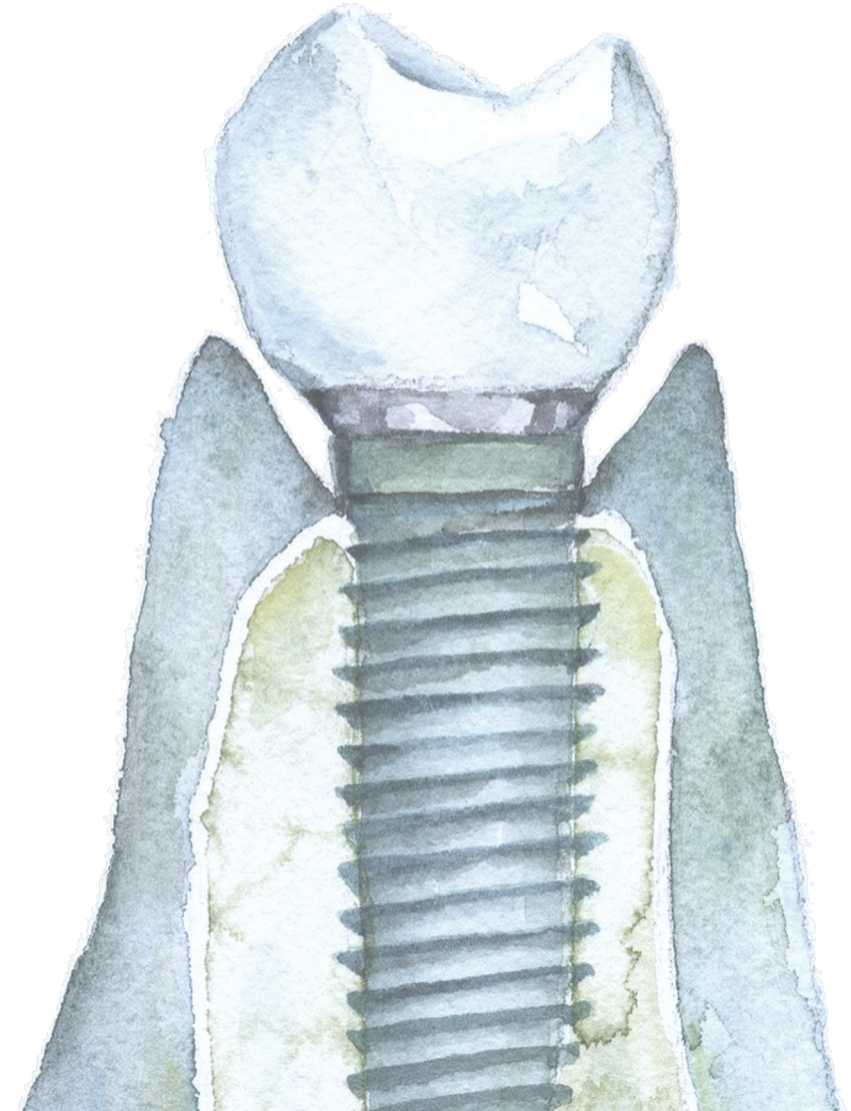
Importance of *Peri-implant Phenotype* for Implant health

- Thin tissue phenotype and inadequate KMW (<2 mm) considered significant risk indicators for peri-implant disease and pain/discomfort during brushing.
- Dental implants should be placed "as deep as necessary, but as shallow as possible".
- Increased keratinized mucosa via soft tissue grafting is associated with a significant reduction in probing depth, soft tissue dehiscence, plaque index and improvement in aesthetics



Importance of *Peri-implant Phenotype* for Implant health

Understanding the impact of different dimensional and morphologic features of the peri-implant mucosa on health and esthetic outcomes is fundamental to make appropriate clinical decisions in the context of tooth replacement therapy with implant-supported prostheses.



“With Great Power
Comes Great Responsibility”

- *Uncle Ben, Spiderman*



The *Cognitive Clinician* Approach

- First, we must appreciate that all this knowledge represents the culmination of years of histological and clinical studies which best support tissue health
- We know that when tissues are subject to inflammation, trauma, close proximity to restorative margins, or orthodontic treatment, these periodontal phenotype structures are challenged.
- We also know with PhMT, we have surgical intervention strategies to make the tissue phenotype more resistant to remodeling effects.
- So, one can either respond reactively, in which case some of this issues discussed may occur and continue until the clinician takes the time to appreciate the tissue changes.

The *Cognitive Clinician* Approach

- Or a cognitive clinician can respond proactively, and recommend/refer the patient for PhMT such as gingival grafting, bone grafting/augmentation, or corticotomy-bone grafting (surgically facilitated orthodontic therapy to alter the tissue phenotype in preparation for possible pathologic/iatrogenic insults).
- The **damaging results associated with peri-implantitis or orthodontic movement of teeth out of the bony housing may have significantly negative impacts and are more challenging to treat.**



Thank you!



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[@gumsandroses](https://www.instagram.com/gumsandroses)