Clinical Remarks on the Significance of Tooth Malposition and Papillae Dimension on the Prediction of Root Coverage

When it comes to complete root coverage of exposed root surfaces, several limiting factors have been suggested. Although tooth malposition and papillae dimension are capable of influencing root coverage, they have not received sufficient emphasis in the literature. Therefore, the aim of the present commentary is to discuss the impact of tooth malposition and papillae dimension on root-coverage outcomes. This commentary combines evidence from the literature with the authors’ experience. Limited evidence is available in the literature regarding the influence of tooth malposition on root-coverage outcomes. Severe buccal displacement and tooth extrusion and/or rotation may limit the amount of achievable root coverage, and the cementoenamel junction should no longer be considered the landmark for root coverage in these cases. The relationship between papillae dimension and root coverage has been tested in different clinical conditions and by applying different root-coverage approaches, thereby resulting in contradictory outcomes. The clinical experience of the authors suggests that having wider papillae is advantageous for coronally advanced flap and tunnel flap preparations and connective tissue graft stabilization. Although scientific evidence and the authors’ clinical experience suggest that papillae dimension can play a major role in determining the surgical management of soft tissues and the amount of achievable root coverage, further studies are necessary to evaluate to which extent papillae dimensions contribute to treatment outcomes.


Gingival recession is defined as the apical shift of the gingival margin with the concomitant exposure of the root surface in the oral cavity.1,2 This condition is often associated with patient esthetic concerns, dental hypersensitivity, root caries, and noncarious cervical lesions.1–4 Although the etiology of gingival recession remains unclear, several predisposing and precipitating factors have been suggested1,5 and recently outlined in the 2017 American Academy of Periodontology/European Federation of Periodontology World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions.2,6 Several conditions, such as the interproximal attachment level, a thin periodontal phenotype, absence of attached gingiva and keratinized gingiva, shallow vestibular depth, the presence of frenula, and tooth location, have been identified as parameters that may negatively affect the amount of root coverage.1,2,5,7,8 As a matter of fact, the impact of severe tooth malposition, rotation, extrusion, and papillae dimension on root-coverage outcomes have not been included among the mentioned parameters, as they had very little emphasis in the literature at time of the workshop. However, some recent studies have provided additional, useful information to better understand their potential impact.9,10

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The aim of this paper is to present a complementary remark to the 2017 World Workshop classification on mucogingival conditions in the light of more recent publications and to contribute a discussion on the significance of tooth malposition and papillae dimension as prognostic root-coverage determinants, combining evidence from the literature with the authors’ experience.

**Tooth Malposition as a Negative Prognostic Root-Coverage Determinant**

Tooth malposition could be envisioned from two different perspectives: (1) severe buccal displacement; (2) extrusion and/or rotation.

Severe buccal displacement of teeth is associated with significant resorption of the buccal bone plate (bone dehiscence), frequently extending far more apically than the apical level of the gingival recession (Fig 1). This condition might severely influence the healing pattern of both free gingival grafts and coronally advanced flaps. When applying a free gingival graft in such a condition, the blood supply can be very scarce, resulting in graft necrosis. In addition, the soft tissue covering buccally oriented teeth is compromised in terms of thickness and width (thin phenotype). It is well known that a thin flap may not receive sufficient blood supply during healing, creating the conditions for flap dehiscence or contraction when it is coronally advanced.

Other conditions attributable to tooth malposition, such as rotation and/or extrusion, can prevent the achievement of complete coverage of the exposed root surface when the cementoenamel junction (CEJ) serves as the landmark for root coverage. In a rotated tooth, there is an alteration in the relationship between the papillae and the CEJ: The CEJ becomes closer to the tip of the papillae on one side but further away to the other papillae, similar to papillae loss induced by trauma (Fig 2). Bone resorption/remodeling may also occur on one side of the tooth, depending on the direction and degree of the rotation; these conditions might prevent the achievement of complete root coverage. Nevertheless, this should not be interpreted as a failure of the procedure and instead be seen as an anatomical limitation that should be explained to the patient prior to the surgery. In his classification that has been used for more than 30 years, Miller defined Class III recessions as a condition characterized by bone or soft tissue loss in the interdental area or malpositioning of the teeth, preventing the possibility of obtaining 100% root coverage.

Similarly, in an extruded tooth, the CEJ is found exposed at a more coronal position (as happens in any attachment loss) and closer to the tip of the papillae, causing a bilat-
eral reduction/loss of the interproximal soft tissue height (Fig 3). This anatomical condition will prevent the root coverage from reaching the CEJ level. A method for predetermining the line of root coverage (defined as the level at which the soft tissue will remain stable after healing from the root-coverage procedure) has been suggested in these clinical scenarios as an alternative to using the CEJ as the reference (Fig 3). Although the hypothetical line of root coverage may allow for a better evaluation of the efficacy of the root-coverage procedure, there is no doubt that this clinical reference does not match the CEJ, and this may have an impact on the patients’ perception of the treatment.

Fig 2  Gingival recessions in rotated teeth. The dotted red line identifies the anatomical CEJ.

Fig 3  Root coverage of an extruded tooth. The line of root coverage was used as the reference instead of the CEJ. The dimension of the ideal papilla is based on the adjacent, homologous, non-extruded teeth. This dimension is then reported apically from the tip of the two anatomical papillae and horizontally projected toward the rotated/extruded tooth, identifying two points that are then connected by a scalloped line, which represents the line of root coverage (or “clinical” CEJ). The extrusion is then compensated with composite restoration at the level of root coverage. The red line identifies the anatomical CEJ, and the white dotted line identifies the maximum level of root coverage.
Papillae Dimension as a Prognostic Root-Coverage Determinant

Papillae dimension is believed to have an important impact on the surgical management of soft tissues during periodontal plastic surgery: Once deep epithelialized, they become the coronal vascular bed for the coronally positioned soft tissues.15 Narrow and shallow papillae are difficult to deep epithelialize and represent a weak anchorage for both the flap and the connective tissue and free gingival grafts. In the tunnel approaches, narrow papillae have a higher risk for tearing during the tunnel flap preparation compared to wider papillae, which may in turn compromise the blood supply, reducing the significance of preferring the tunnel approach over a pedicle flap.15,17 Having wider papillae for the tunnel technique allows for easier detachment during the flap preparation. However, the existing evidence makes it very complex to draw any definitive conclusion regarding the influence of papilla dimension on the achievable root coverage.18–20 Saletta and coworkers performed measurements on 33 photographed single gingival recessions using a specific software and concluded that their coronally advanced flap (CAF) outcomes were not significantly correlated to the papilla area or height.20 However, they observed that complete root coverage was more frequent in sites with short adjacent papillae than in sites with higher papillae. The authors speculated that their finding was likely attributed to the gingival phenotypes of the patients, expectancy thick in cases of short and wide papillae.20 Berlucchi et al found contradicting results in a study on single recessions treated with CAF plus enamel matrix derivatives, concluding that “there is not a clear relation between root coverage and other anatomical features as papilla width, papilla height, and the amount of bone on the vestibular side.”18

A controlled study performed on single and multiple gingival recessions applied a bilaminar technique with either connective tissue graft (CTG) or acellular dermal matrix allograft, reporting that papillae height and width were significant positive predictors for the amount of achievable root coverage.19 The authors claimed that differences in study design and the definition of the papilla dimension may have contributed to the contrasting results compared to Saletta et al.20 Similarly, a prospective study performed on single recessions treated with CAF + CTG, among other factors, identified a papilla height ≤ 1 mm as an independent risk factor related with the inability of achieving a complete root coverage (odds ratio: 97.3).10 Nevertheless, Cairo and coworkers showed that, using CAF + CTG, complete root coverage can be achieved in more than 80% of recession-defect cases with interproximal attachment loss ≤ 3 mm.21 The importance of papilla height has also been recently confirmed in the tunnel technique by Aroca et al; the authors found that the smaller the distance from the tip of the papilla to the contact point at baseline (the higher the papilla), the greater the mean root coverage.9 Interestingly, when the distance from the tip of the papilla to the contact point was < 3 mm, the probability of obtaining a complete coverage was found to be 89% for the maxillary teeth but down to 34% among the mandibular teeth.9 Differences in the root coverage outcomes between maxillary and mandibular dentition have also been demonstrated in the literature.7–9,17 While it has often been speculated that a high muscle pull and the shallow vestibular depth account for the lower predictability of treating recessions in the mandible,8,9 it can further be speculated that papillae dimension, usually narrower and smaller in the mandible, might also contribute to these differences in the root-coverage outcomes.

Lastly, it has to be emphasized that the papillae dimension is influenced by several factors, such as the distance from the bone crest to the interproximal CEJ (which is considered the most significant determinant for the presence of papillae), age, buccal and proximal CEJ, crown width, and the interproximal soft tissue thickness.22–24 In particular, an ideal papilla is strongly associated with a distance ≤ 5 mm from the bone crest and the contact point of and with an interproximal gingival tissue thickness ≥ 1.5 mm; it was also estimated that for each year of increasing age, the papilla height significantly decreases by 0.012 mm.25

The literature is completely lacking any information on a potential correlation between interproximal attachment loss (as in type 2 reces-
sions), bone loss, and papilla dimension. This might explain, at least in part, some of the conflicting outcomes reported in the above cited studies.

**Summary of Evidence and Clinical Recommendations**

Limited evidence is available in the literature regarding the influence of tooth malposition on root-coverage outcomes (level of evidence C\(^26\)). It has been suggested that severe buccal displacement and tooth extrusion and/or rotation limit the amount of achievable root coverage.\(^{13}\) The CEJ should no longer be considered the landmark for root coverage in these cases. While the healing pattern of the soft tissue graft and the flap is likely to be compromised in severely buccally displaced teeth, tooth extrusion and/or rotation even in absence of interdental attachment loss are associated with reduction of interdental papillae height, which negatively affects the stability of the flap in a coronal position.

Orthodontic treatment prior to periodontal plastic surgery to reposi-
tion a buccally oriented or a rotated tooth should be considered the treatment of choice for achieving root coverage at the level of the CEJ. Nevertheless, cost-benefit of this combined treatment should be pondered upon with the patient, bearing in mind that good esthetic outcomes can also be obtained with the placement of composite restoration above the line of root coverage.

The relationship between papillae dimension and root coverage has been tested in different clinical scenarios while applying different root-coverage approaches, thus leading to contradictory outcomes (level of evidence B\(^26\)). Differences in conclusions among studies can likely be due to the lack of a clinical consensuses on a classification for papilla and on a measurement methodology, as well other factors that have been observed to confound comparative relationships among root-coverage studies.\(^{27,28}\)

Bearing in mind that little evidence is available in the literature regarding papillae dimension and its classification in relation to root-coverage procedures, the present authors’ clinical experience suggests that four types of scenarios can be observed in the clinical setting: (1) partially missing papilla without clinical attachment/bone loss; (2) partially missing papilla associated with interdental attachment/bone loss (Fig 4); (3) intact papilla without clinical attachment/bone loss; and (4) intact papilla associated with interdental clinical attachment/bone loss (Fig 5).

In some instances, aggressive interdental oral hygiene or the presence of interdental inflammation may lead to the loss of the tip of the papilla, particularly in thin and poorly vascularized situations, even in the absence of interdental attachment loss. The partial loss of the papilla height can result in a reduced vascular bed for the coronal advancement of the flap, therefore reducing the potential to obtain complete root coverage. CAF or tunnel approach-
Fig 4 The presence of open embrasure spaces due to loss of the interproximal soft tissue height caused by the interproximal bone loss and CAL loss allowed deepithelialization of the anatomical papillae on the occlusal aspect. Thus, increasing the vascular bed for the CAF was possible to obtain complete root coverage. (a) Baseline clinical and (b) radiographic views. (c) After the deepithelialization of the anatomical papillae, a CTG was placed and stabilized. (d) Flap sutturing. (e) Clinical view at 1 year.
Fig 5 The presence of an anatomical diastema allows the deepithelialization toward the palatal aspect of the interproximal papilla, increasing the vascular nourishment for the flap. (a) Baseline clinical and (b) radiographic views. (c) CTG sutured at the base of the deepithelialized papillae. (d) Flap suturing. (e) Complete root coverage was achieved despite the clinical and radiographic bone loss. The results were well maintained at the 3-year follow-up visit.

coverage in addition to the interdental CAL loss. Up to now, the literature is without any information on a potential correlation between interproximal attachment loss (as in recession types 2 and 3), bone loss, and papillae dimension. This might explain some of the conflicting outcomes reported in the above cited studies.
Conclusions

The present article discusses the importance of tooth malposition and papillae dimension as factors capable of influencing complete root coverage. In malpositioned teeth, emphasis is placed upon the distinction between the “conventional” complete root coverage to the natural CEJ and the maximum “achievable” coverage in these clinical scenarios, and the subsequent potential patient’s concern in bearing an “unsuccessful” therapy. Although scientific evidence and the present authors’ clinical experience suggest that papilla dimension can play a major role in determining the surgical management of soft tissues and the amount of achievable root coverage, further studies are necessary to evaluate to which extent papillae dimensions contribute to treatment outcomes.

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References


