Therapeutic Prognosis System for Root Coverage Procedures

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Although several techniques and materials have been adopted to treat gingival recession, the therapeutic prognosis of various treatment modalities is not well established. This article proposes a multidimensional therapeutic prognosis system for the treatment of gingival recession based on the currently available literature. Gingival defect characteristics, patient behavioral habits, and surgical- and anatomical-related factors that may affect the outcome of root coverage procedures are reviewed. A therapeutic prognosis system is provided to enable clinicians to analyze these factors prior to the root coverage procedures. Three clinical cases are also discussed to demonstrate the assessment and validation of this therapeutic prognosis system.


Gingival recession is defined as an apical migration of the gingival margin beyond the cementoenamel junction (CEJ).\textsuperscript{1} With an increased amount of root exposure, individuals with gingival recession could experience pain or sensitivity on teeth and have esthetic concerns. Gingival recession increases with age and incrementally so for each decade of life.\textsuperscript{2} In the United States, 90\% of the population has at least one site with $\geq 1$ mm of gingival recession, whereas approximately 40\% have at least one site with $\geq 3$ mm of recession by the age of 60.\textsuperscript{2} This mucogingival deformity has an extremely high prevalence, and thus a prognosis system to predict the outcome of root coverage procedures is necessary. Because the treatment outcome depends on multiple factors and not the procedure type alone, this article proposes a multidimensional prognosis system for the treatment of gingival recession based on the currently available literature.

\textbf{Defect Factors}

\textbf{Defect Classification}

Defect classification plays one of the most critical roles in the predictability of root coverage outcome. Miller Class I and II recession defects could...
be predictably covered with various techniques and materials, such as free gingival graft (FGG),
connective tissue graft (CTG), or enamel matrix derivative combined with a coronally advanced flap (CAF).
Although Miller Class III recessions may be completely covered after soft tissue grafting procedures, it is not always predictable. However, complete root coverage is not anticipated for Miller Class IV defects due to the existing severe attachment and bone loss.

In addition to the Miller classification, another classification system proposed by Cairo et al has been adopted. Similar to the Miller classification, complete root coverage can be predictable with various materials and techniques for RT1 defects. However, achieving complete root coverage for RT2 defects is questionable due to the loss of interproximal attachment. RT3 defects have an unfavorable prognosis for complete root coverage due to the extensive interproximal attachment loss.

Defect Size

Sullivan and Atkins classified gingival recession into four categories: deep wide, shallow wide, deep narrow, and shallow narrow. Both deep wide and deep narrow recessions extend into the alveolar mucosa, whereas shallow wide and shallow narrow recessions are bordered by a narrow band of gingiva. Based on this study, narrow defects (deep or shallow) are more likely to result in root coverage than wide defects. Deep and wide defects are the most difficult to treat due to their limited blood supply, exposure of the denuded root surface, and complexity of the treatment.

Defect Location and Step

Although it is useful to categorize different degrees of root exposure in relation to the surrounding periodontium, neither the Miller nor Cairo classification systems take into account the nature of the exposed root surface, and in particular the presence or absence of a cervical discrepancy. Pini-Prato et al proposed a classification system of four different classes of root surface discrepancies using the identifiable CEJ and presence or absence of a cervical discrepancy (cervical step): Class A–, A+, B–, and B+. Class A– and A+ represent gingival recession associated with an identifiable CEJ (Class A) with the absence (–) or presence (+) of a cervical step, respectively. In contrast, Class B– and B+ refer to defects associated with an unidentifiable CEJ (Class B) with the absence (–) or presence (+) of a cervical step, respectively. The study pointed out that 46% of gingival recessions showed an identifiable CEJ without a cervical step (Class A–), thus allowing for a more predictable outcome of the root coverage procedure. However, 15% of the cases did not show an identifiable CEJ (Class B–), indicating that a correct diagnosis and proper prognosis could not be determined in these cases. Furthermore, the presence of a cervical step (Classes A+ and B+) was observed in 38% of gingival recessions. In particular, in 14% of the cases (Class A+), surface abrasion was localized only on the root surface, whereas in 24% cases (Class B+), it involved both the root and the crown. Since the presence of a cervical step limits the adaptation of grafting materials and compromises the vascularization and wound stability at the recipient site, these conditions should be taken into consideration and may require different treatment approaches (ie, a combination of restorative and surgical treatments) to achieve an ideal outcome.

Cortellini and Bissada Classification

Cortellini and Bissada recently reviewed several classifications for gingival recession as one of the consensus papers of the 2017 World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions. The factors included in their modified classification are periodontal tissue phenotype, recession severity, soft tissue dimension of the residual gingiva, and presence/absence of carious and noncarious cervical lesions. Because all of these factors have a great impact on the therapeutic prognosis of the treatment outcome, the defect factors are summarized in Table 1.
Among the precipitating factors that affect tooth recession, smoking can cause make patients 2× to 8× more susceptible to periodontal disease than nonsmokers. Smoking also can interfere with the predictability of periodontal surgery. Because there is a relationship between smoking and attachment loss, it is assumed that the therapeutic prognosis of root coverage outcome would be dose-dependent. Therefore, the present authors propose assigning nonsmoking patients with a “favorable” therapeutic prognosis (Table 1). For patients who are light smokers (< 10 cigarettes per day), the prognosis would be considered “questionable.” For patients who are heavy smokers (≥ 10 cigarettes per day), the prognosis for the root coverage procedure would be “unfavorable.”

Oral hygiene habit is another patient factor that can contribute to gingival recession. For instance, vigorous brushing techniques with stiff bristles increase the risk of gingival...

### Table 1 Proposed Multidimensional Therapeutic Prognosis System

<table>
<thead>
<tr>
<th>Patient Factors</th>
<th>Surgical Factors</th>
<th>Anatomical Factors</th>
<th>Therapeutic Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect factors:</td>
<td>Overcorrection after suturing</td>
<td>Flap thickness</td>
<td>If all factors are in the “favorable” category, complete root coverage can be expected, and the outcome is predictable.</td>
</tr>
<tr>
<td>Miller classification or Cairo classification</td>
<td>≥ 2 mm</td>
<td>Thick (≥ 1 mm); thin (&lt; 1 mm), with use of autogenous graft</td>
<td>If any of the factors falls in the “questionable” category, partial root coverage can be expected. Complete root coverage may be achievable, but the outcome is not predictable.</td>
</tr>
<tr>
<td>Defect size</td>
<td>None (passive coronal displacement over CEJ)</td>
<td>Thin (&lt; 1 mm), with use of nonautogenous material</td>
<td>If any of the factors falls in the “unfavorable” category, complete root coverage cannot be expected. Partial root coverage may be achievable, but the outcome is not predictable.</td>
</tr>
<tr>
<td>Defect location and step</td>
<td>Slight (passive coronal displacement at CEJ)</td>
<td>Thin (&lt; 1 mm), without using any additional material</td>
<td></td>
</tr>
<tr>
<td>Patient factors</td>
<td>Flap tension</td>
<td>Vestibule depth/frenal attachment</td>
<td></td>
</tr>
<tr>
<td>Smoking status</td>
<td>Significant (no passive coronal displacement)</td>
<td>Deep vestibule; no significant frenal pull</td>
<td></td>
</tr>
<tr>
<td>Oral hygiene habits</td>
<td>Likely to comply</td>
<td>&gt; 0 mm, &lt; 2 mm</td>
<td></td>
</tr>
<tr>
<td>Overcorrection after suturing</td>
<td>Might comply</td>
<td>No vestibule space; presence of significant frenal pull</td>
<td></td>
</tr>
<tr>
<td>Flap tension</td>
<td>Unlikely to comply</td>
<td>No keratinized tissue</td>
<td></td>
</tr>
</tbody>
</table>

RT = recession type; CEJ = cementoenamel junction.
recession. Therefore, the present authors propose including oral hygiene habits as a determining factor for the prognosis of mucogingival surgery for gingival recession, as it significantly contributes to the surgical outcomes. For patients who are compliant with oral hygiene instructions and change their habits to adopt nontraumatic methods, it is proposed to assign them a “favorable” therapeutic prognosis (Table 1). Patients who may be willing to change their habits can be assigned a “questionable” prognosis. However, for those who are unlikely to change their habits, an “unfavorable” prognosis is assigned.

**Surgical Factors**

**Overcorrection After Suturing**

Pini Prato et al reported on the importance of the postsurgical position of the gingival margin to achieve complete root coverage. If the flap margin is at the CEJ, the expected outcome of complete root coverage is approximately 17%. If the tissue position is < 1 mm over the CEJ or between 1 mm and 2 mm over the CEJ, the probability of achieving complete root coverage is 50% and 75%, respectively. With a final marginal tissue position ≥ 2 mm over the CEJ, the probability of complete root coverage approaches 100%. Therefore, the postsurgical position of the gingival margin relative to the CEJ greatly affects the predictability of complete root coverage.

**Flap Tension**

Another study done by Pini Prato et al investigated the significance of flap tension in achieving complete root coverage. The study concluded that the higher the flap tension, the lower the amount of recession reduction that can be achieved; after adequate flap release, a passive coronal displacement over the CEJ should be achieved. However, if the passive coronal displacement of the flap after suturing is at the CEJ and does not cover beyond the CEJ, the prognosis of the root coverage procedure becomes questionable. If the flap tension is not released, the prognosis for complete root coverage is unfavorable due to insufficient passive coronal displacement.

**Vestibular Depth and Frenal Attachments**

In order to achieve a stable surgical outcome with soft tissue grafts, a deep vestibule without significant frenal tension is crucial. A deep vestibule facilitates the stability of the graft and provides an ideal recipient bed for the graft to take, while a lack of vestibular depth increases surgical-site instability and poses a threat to the procedure's success. In addition, significant tension from the frenal may pull the gingival margin away from the tooth, resulting in an unstable graft adaptation to the recipient bed.

**Anatomical Factors**

**Flap Thickness**

Studies have shown predictable and complete root coverage with CAF when flap thickness is ≥ 1 mm. However, in cases where a thin phenotype is present, the use of CTG-based procedures combined with CAF are desirable due to their effectiveness in increasing gingival/mucosal thickness. If the initial defect presents without adequate tissue thickness, the utilization of non-CTG-based grafting techniques may not be ideal for changing tissue thickness based on outcomes compared to CTG-based procedures. In addition, performing CAF procedures at sites with an initially thin tissue phenotype without additional grafting materials is unlikely to achieve long-term root coverage.

**Keratinized Tissue Width**

Because the root coverage procedure is often performed together with a CAF, a wide band (≥ 2 mm) of keratinized tissue is beneficial, providing a more stable tissue attachment for maintaining the final CAF position. In contrast, a narrow band (< 2 mm, > 0 mm) of keratinized tissue will be more difficult to handle and suture for stabilizing the tissue graft and achieving an ideal flap position. If a band of keratinized tissue does not exist, an FGG procedure is often recommended to increase the keratinized tissue width before attempting root coverage or to cover deep or wide recessions.
Case 1

A healthy, nonsmoking 51-year-old man sought treatment for his gingival recession (3-mm depth) at the Taipei Veterans General Hospital in Taipei, Taiwan. The patient denied any history of periodontal disease and presented with a localized Miller Class I/Cairo RT1 recession on the facial aspect of his maxillary left lateral incisor. After presenting various treatment options, the patient opted to undergo a root coverage procedure with CTG. According to the proposed prognosis system (Table 1), the treatment was given a “favorable” therapeutic prognosis: For each factor, this patient/site fell into a “favorable” criteria, including his history as a nonsmoker, high patient compliance level, Miller Class I/Cairo RT1 recession defect, identifiable CEJ without a step (A–), deep vestibule without significant frenal pull, keratinized tissue width > 2 mm, and a thick gingival phenotype. During the surgical phase, a small portion of the CTG was left uncovered to achieve overcorrection of the recession defect without utilizing a CAF. As predicted from the prognosis table parameters, the patient achieved complete root coverage on the treated site without any residual recession (Fig 1).

Case 2

A healthy, nonsmoking 35-year-old man sought treatment of his gingival recession at University of California San Francisco (UCSF) Dental Center. The patient denied a history of periodontal disease but presented with generalized Miller Class I/Cairo RT1 recession on the facial aspect of his maxillary anterior teeth (canine to canine; 3 to 4 mm deep). After discussing treatment options, the patient opted to undergo a CAF procedure utilizing a tunneling technique in combination with an acellular dermal matrix (AlloDerm, BioHorizons). According to the prognosis system (Table 1), the treatment was given a “questionable” therapeutic prognosis. The patient fell into a “favorable” category based on his history of being a nonsmoker, having a high patient compliance level, Miller Class I/Cairo RT1 recession defect,
identifiable CEJ with a step ≤ 0.5 mm (A–), deep vestibule without significant frenal pull, and keratinized tissue width > 2 mm. However, the patient also fell into the “questionable” category because he had a wide/shallow defect size and thin gingival phenotype (< 1 mm). As the prognosis system predicted, the patient achieved complete root coverage on most sites of his maxillary anterior dentition, with the exception of the right central incisor, where a 1-mm residual recession defect remained (Fig 2).

Case 3

A nonsmoking 55-year-old man with a medical history of hypothyroidism and hypertension was referred to the UCSF Dental Center for surgical treatment of his generalized gingival recession. The patient received periodontal maintenance therapy every 6 months. His periodontal status showed no probing depths larger than 4 mm, < 20% bleeding on probing, and generalized gingival recession with interdental bone loss. His clinical examination revealed a thin gingival tissue phenotype with minimal keratinized tissue and generalized abrasion due to an aggressive brushing habit. Using the proposed prognosis system (Table 1), the initial therapeutic prognosis for complete root coverage was considered favorable, as the patient was a nonsmoker and willing to comply with future home-care instructions. However, several factors in the patient’s clinical presentation—including Miller Class IV/Cairo RT3 defect classification, wide and deep recession defects (3 to 6 mm deep) with a > 0.5-mm step (A+), thin tissue phenotype (< 1 mm), and inadequate keratinized tissue width (< 2 mm)—led to an unfavorable therapeutic prognosis for his recession defects. The presence of a shallow vestibular depth with significant frenal pull were also factors contributing to a questionable prognosis. Ultimately, this patient was determined to have an overall unfavorable therapeutic prognosis for treating his recession defects. After communicating with the patient regarding his treatment prognosis with the aid of the prognosis system, the patient opted not to receive surgical treatment for root coverage (Fig 3).

Conclusions

The goals for proposing this multidimensional therapeutic prognosis system are to improve case selection, risk assessment, surgical preparation, and patient education, and ultimately to achieve a better clinical outcome. The comparisons of
the proposed prognosis system to other existing diagnostic systems are summarized in Appendix Table 1 (all Appendix Tables can be found in the online version of this article, available at quintpub.com/journals).

With the development of this therapeutic prognosis system, the authors hope to shed light on the unpredictability of soft tissue root coverage procedures, a topic that often is not completely addressed in patient communications. This multidimensional prognosis system can enhance patient education by helping them better understand the potential outcomes of their proposed treatment. In addition, this prognosis system offers the clinician a tool that considers various patient and clinical characteristics so that the surgical outcomes have an increased probability of success.

Acknowledgments

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References


Fig 3 A 55-year-old man presented with generalized gingival recession and interdental bone loss. Several factors—including the defect classification (Miller Class IV/ Cairo RT3), wide and deep defect, step > 0.5 mm, thin tissue phenotype (< 1 mm), and inadequate keratinized tissue width—contributed to an unfavorable therapeutic prognosis for a root coverage procedure.
## Appendix

### Appendix Table 1 Comparisons of the Multidimensional Therapeutic Prognosis System to the Miller and Cairo Classification Systems

<table>
<thead>
<tr>
<th>Reference</th>
<th>Miller&lt;sup&gt;5&lt;/sup&gt;</th>
<th>Cairo&lt;sup&gt;4&lt;/sup&gt;</th>
<th>Proposed prognosis system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I: Recession not extending to MGJ</td>
<td>100% root coverage</td>
<td>RT1: Recession with no loss of interproximal attachment</td>
<td>100% root coverage</td>
</tr>
<tr>
<td>II: Recession to or beyond MGJ</td>
<td>100% root coverage</td>
<td>100% root coverage</td>
<td>Favorable: If all factors are in “favorable” category in Table 1</td>
</tr>
<tr>
<td>III: Bone or soft tissue loss in interdental area and/or malposed teeth</td>
<td>Partial root coverage</td>
<td>RT2: Recession with loss of interproximal attachment, and less than or equal to buccal attachment loss</td>
<td>Partial root coverage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partial root coverage</td>
<td>Questionable: If any factors all in “questionable” category in Table 1</td>
</tr>
<tr>
<td>IV: Bone or soft tissue loss in interdental area and/or severe malposed teeth</td>
<td>Root coverage not expected</td>
<td>RT3: Recession with loss of interproximal attachment, and greater than buccal attachment loss</td>
<td>Root coverage not expected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Root coverage not expected</td>
<td>Unfavorable: If any factors fall in “unfavorable” category in Table 1</td>
</tr>
</tbody>
</table>

Clinical use Diagnostic system Diagnostic system Therapeutic prognosis system

MGJ = mucogingival junction; RT = recession type.