Enhancing Periodontal Health Through Regenerative Approaches

Periodontal Soft Tissue Root Coverage Procedures: Practical Applications From the AAP Regeneration Workshop

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Focused Clinical Question: How should gingival recession (GR) defects be managed based on current evidence?

Summary: The purpose of this practical application is to illustrate the management of GR defects with a primary outcome goal of complete root coverage. The consensus in dental literature and among expert clinicians is that root coverage may be attained through the application of different procedures and that outcomes are generally measured by reduced defect depth, gain in clinical attachment, and an increase in keratinized tissue (KT). These procedures may include the use of: 1) subepithelial connective tissue graft (SCTG); 2) coronally advanced flap; 3) free gingival graft; and 4) soft tissue graft substitutes (acellular dermal matrix and xenogeneic collagen matrix materials) and biologics (recombinant human platelet-derived growth factor and enamel matrix derivative). The variability in these techniques revolves around the inclusion or avoidance of a palatal donor graft. The decision as to how to approach a specific clinical GR-type defect should be a combination of considerations relative to the clinician's surgical goals and the patient's understanding of the anticipated outcome. The associated systematic review (Chambrone and Tatakis, *J Periodontol* 2015;86(Suppl.):S8-S51) provides clear evidence that SCTG-based procedures provide the best outcome for mean and complete root coverage, as well as an increase in KT. Patient-reported outcomes, a topic that needs additional research, should be considered in the decision-making process.

Conclusion: Based on the available evidence and the illustrated cases included in this practical application, root coverage can be predictably achieved and a successful clinical outcome can be maintained long term. *Clin Adv Periodontics* 2015;5:2-10.

Key Words: Acellular dermis; enamel matrix proteins; gingival recession; surgical flaps; transplantation, autologous.

See related systematic review and consensus report in the Journal of Periodontology *(February 2015, Vol. 86, No. 2s) at www.joponline.org*.

Background

The ultimate goal of dental and periodontal care is to maintain the health, comfort, function, and esthetics of the natural dentition. This includes the treatment of gingival recession (GR) defects to restore proper soft tissue anatomy and thus minimize GR-associated complications. GR, defined as the migration of the marginal soft tissue apical to the cemento-enamel junction (CEJ), is accompanied by alveolar bone dehiscence and a potential reduction in the gingival tissue surrounding the tooth. GR is encountered commonly in adults aged >30 years.[1,2] The exposure of the tooth root and the loss of hard and soft tissue supporting structures ultimately increases the likelihood that the patient will experience: 1) dentinal hypersensitivity; 2) soft tissue discomfort; 3) root surface caries; 4) esthetic concerns; 5) interference with the performance of adequate mechanical plaque control; and 6) greater susceptibility to inflammatory insult.

The most recent evidence available regarding the treatment of GR defects[3,4] indicates that surgical therapeutic approaches are highly predictable for Miller Class I and II single-tooth defects. Challenges for the clinician arise when patients present with Miller Class III and IV defects, as well as multiple-tooth GR defects and lingual/palatal mucogingival concerns.[3,4] A number of systematic reviews and randomized clinical trials have demonstrated the successful use of subepithelial connective tissue graft (SCTG) techniques when treating facial maxillary Miller Class I and II single-tooth defects.[3] However, the data available to guide the management of defects associated with mandibular sites, molar sites, and palatal/lingual sites are limited.[3] Therefore, the clinicians can only rely on case reports and empirical evidence to make decisions regarding

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appropriate care in such sites.[3] To understand the management and appropriate treatment decisions relative to delivering the most predictable therapeutic modality, it is important to be familiar with the Miller classification of GR defects.[5]

Miller Classification of Mucogingival Defects: Clinical Presentations

All patients presented in this paper provided written or oral informed consent prior to treatment. The Miller classification system is described as follows. For Class I (Fig. 1), GR does not extend to or beyond the mucogingival junction, there is no loss of interdental bone or soft tissue present, and full root coverage can be anticipated. For Class II (Fig. 2), GR extends to or beyond the mucogingival junction with no loss of interdental bone or soft tissue, and full root coverage may be anticipated. For Class III (Fig. 3), GR extends to or beyond the mucogingival junction. Loss of interdental bone or soft tissue is apical to the CEJ but coronal to the apical extent of the GR. Malposition of teeth may be present, and complete root coverage (CRC) is not anticipated. For Class IV (Fig. 4), GR extends to or beyond the mucogingival junction. Loss of interdental bone or soft tissue reaches the level of the apical extent of the GR. Teeth may be severely malposed, and root coverage is not anticipated.

Decision-Making Process

The decision-making process for treating GR defects and the prognosis for specific sites depend on the Miller classification of the defect and other factors outlined below. The clinical decision-making process, including alternatives and clinical outcomes anticipated for the root-coverage procedure to treat GR defects, is presented in Figures 5 through 8.

Patient-Specific Factors

The periodontal literature indicates that cigarette smoking has a significant negative effect on oral wound healing,[6] with oral tissues exhibiting decreased vascularity. Systematic reviews and clinical trials have shown that smoking is associated with poorer root coverage outcomes.[6,7] Smokers should be advised of these potential surgical outcomes.

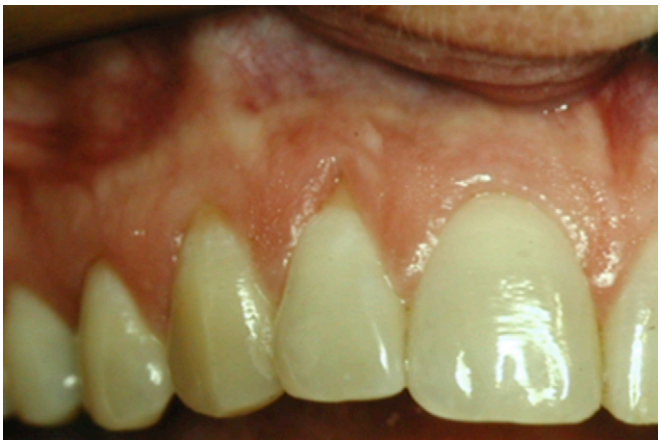

FIGURE 1 Clinical representation of Miller Class I mucogingival defect.

Site-Specific Factors

Beyond the Miller classification of the GR defect, other site-related factors may include: 1) depth of defect; 2) presence of frenum attachment; 3) root prominence; 4) root-surface caries; 5)

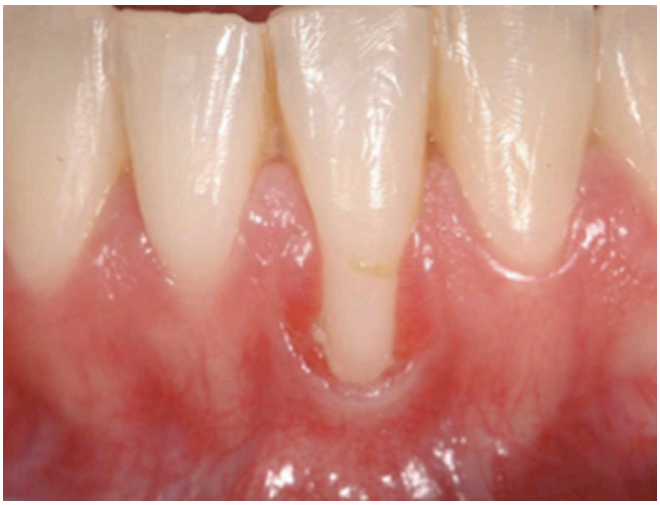

FIGURE 2 Clinical representation of Miller Class II mucogingival defect.

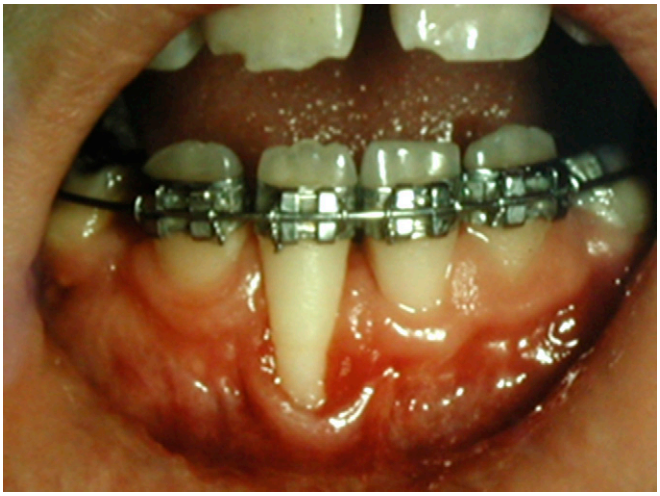

FIGURE 3 Clinical representation of Miller Class III mucogingival defect.

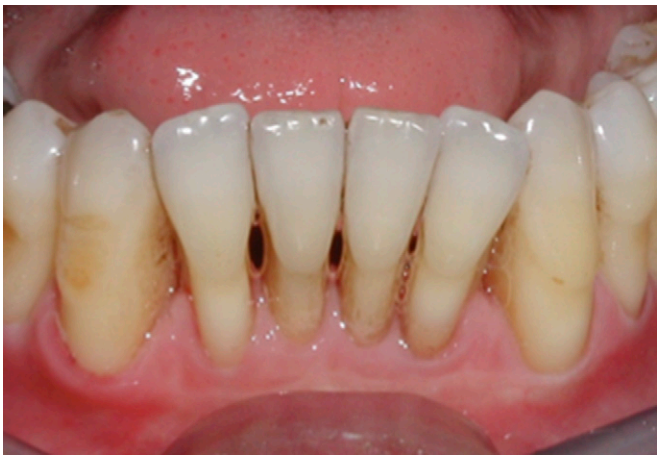

FIGURE 4 Clinical representation of Miller Class IV mucogingival defect.

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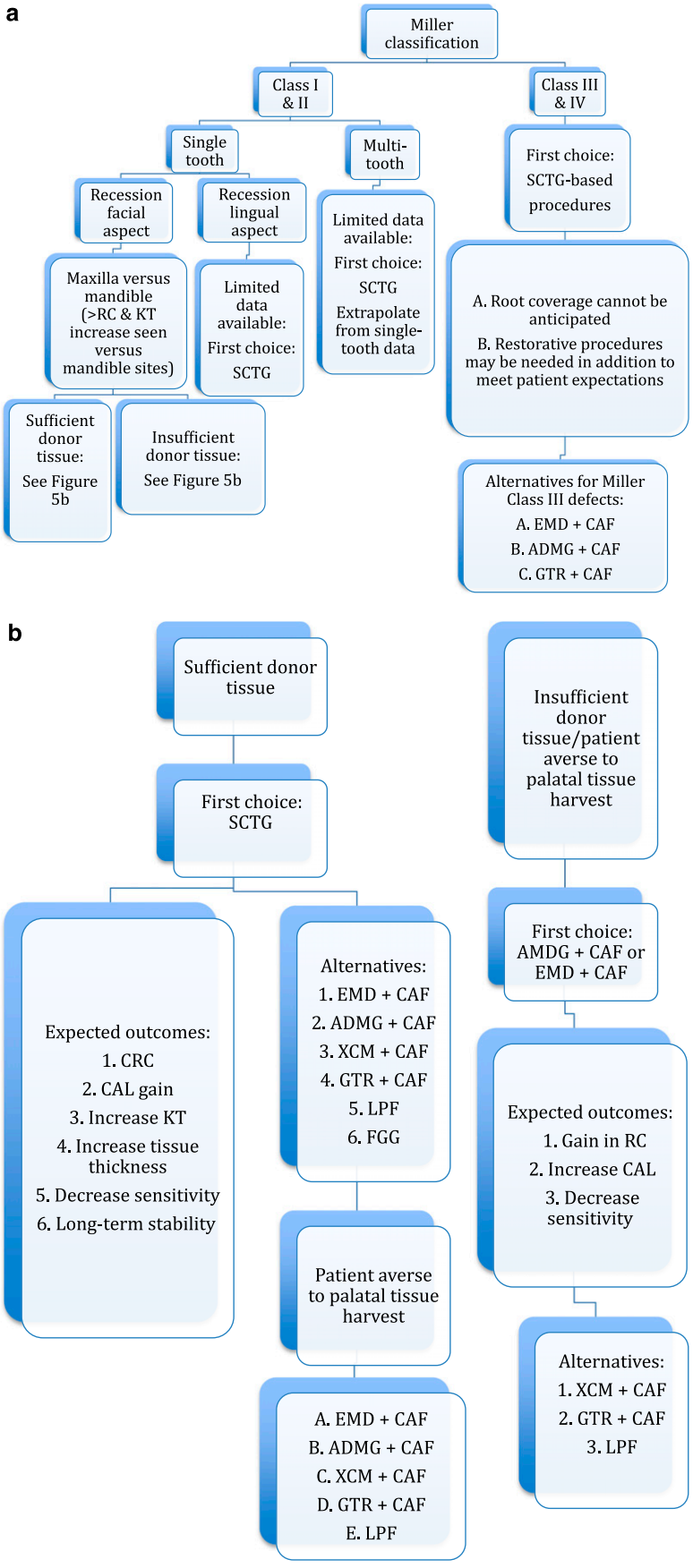

FIGURE 5a Decision tree providing clinical guidance for patient care in the treatment of GR defects. **5b** Decision tree detailing clinical guidance for patient care in cases of Class I and II single-tooth recession on the facial aspect based on the availability of sufficient donor tissue. RC = root coverage; LPF = laterally positioned flap; FGG = free gingival graft.

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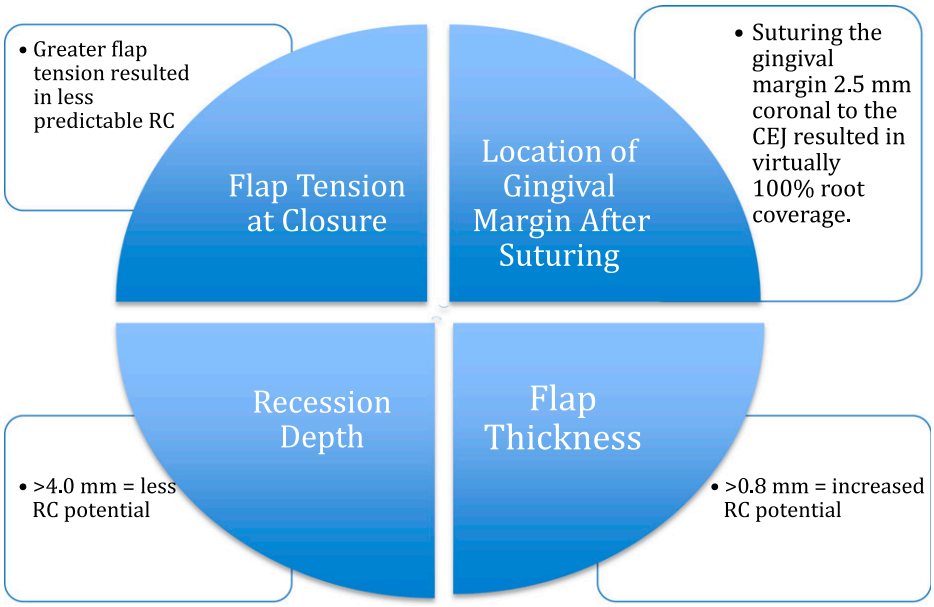

FIGURE 6 Technical factors for treating GR defects. RC = root coverage.

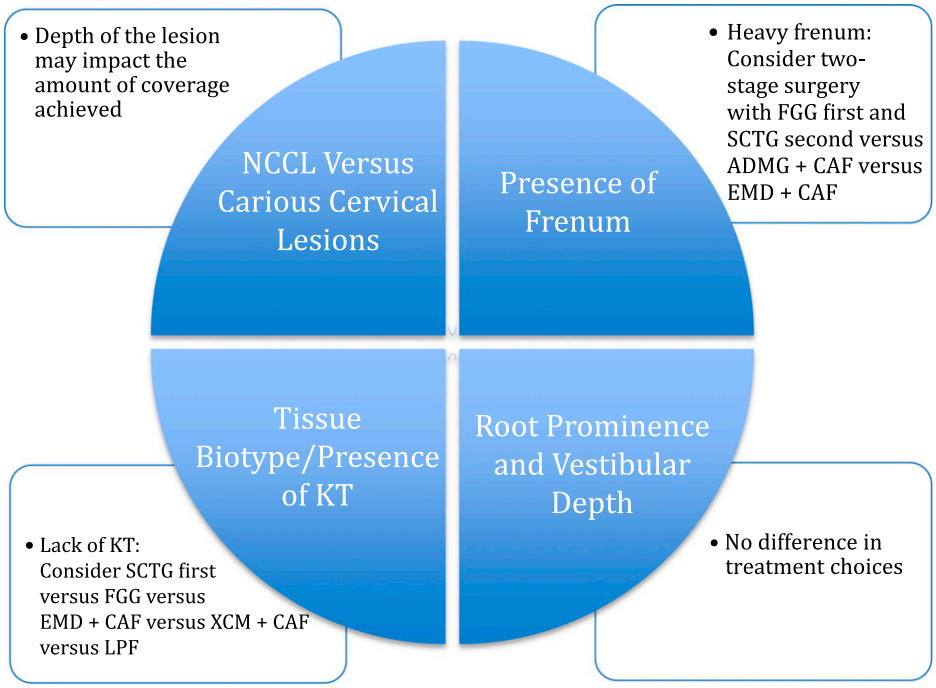

FIGURE 7 Site-specific factors for treating GR defects. NCCL = non-carious cervical lesion; FGG = free gingival graft; LPF = laterally positioned flap.

presence of a non-carious cervical lesion (Fig. 9); 6) vestibular depth; and 7) thin or thick tissue biotype. These factors should be considered when explaining to the patient expected clinical outcomes and the potential for additional treatment needs.

Technical Considerations

The experience of the clinician, biomaterial and surgical technique selection, flap tension at closure, the use of vertical releasing incisions, and the use of microsurgical visual assistance are some of the technical considerations the periodontal surgical specialist should consider during management of a GR defect.

Clinical Application of Evidence

The evidence summarized during the 2014 American Academy of Periodontology Regeneration Workshop[3,4] has been used to guide the clinical decision-making process outlined in this practical application. Evidence is clear that CRC is the definitive clinical outcome expected when a root-coverage procedure is performed.[8-11] It can be argued that there are few high-quality studies available for many soft tissue root coverage procedures that have been in clinical use for many years and that some patient-centered outcomes, such as esthetics, patients' preferences, and function, may play an equally important part in the implementation of novel

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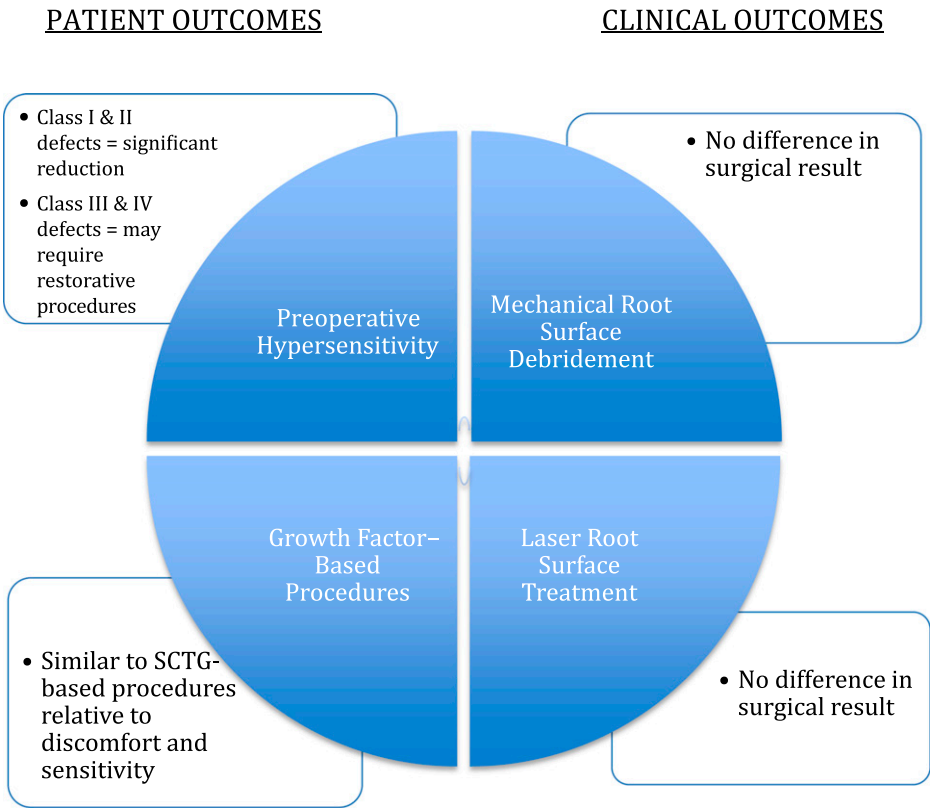

FIGURE 8 Outcome assessment for treating GR defects.

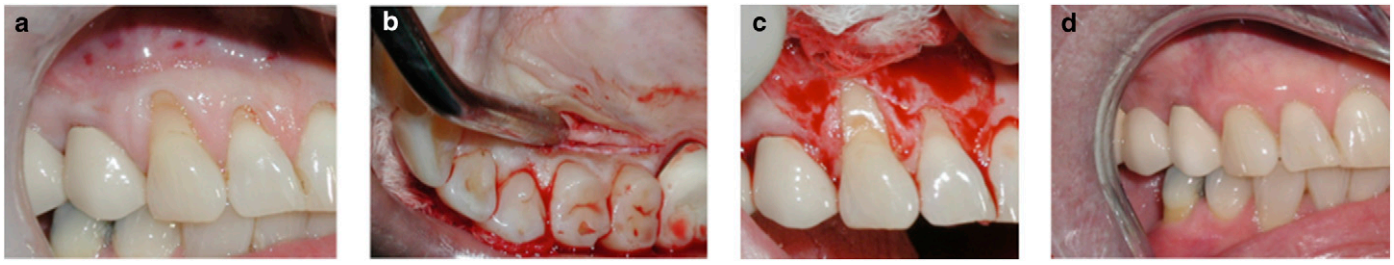

FIGURE 9a Initial presentation of maxillary Miller Class I defects and restored non-carious cervical lesion on the canine. **9b** Palatal harvest of SCTG. **9c** Split-thickness flap elevated; composite restoration removed. **9d** Stable clinical outcome at the 8-year follow-up.

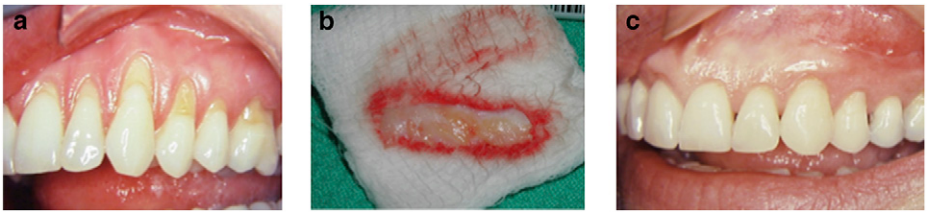

FIGURE 10a Initial presentation of maxillary Miller Class I defects. **10b** SCTG harvested. **10c** Stable clinical outcome at the 17-year follow-up.

surgical techniques in the future. Additionally, systematic reviews per se may not be clearly designed to translate the current evidence into practical decision guidance for common day-to-day clinical scenarios.

In the associated consensus report published in the *Journal of Periodontology*,[4] the authors reached consensus guided by the systematic review[3] that all root coverage procedures promote concomitant significant GR depth reduction and clinical attachment level (CAL) gain (Fig. 10).[4,12-16] With respect to the KT width, SCTG-, acellular dermal matrix graft (ADMG)- and xenogeneic collagen matrix (XCM)-based procedures led to the most significant gains. Another common conclusion was the indication of the SCTG as the gold standard, irrespective of the flap procedure approach performed, not only because of the better aforementioned outcomes, but due to the significant number of sites exhibiting CRC, better cost-effectiveness, and superior long-term stability when compared to coronally advanced flap (CAF) alone, CAF + guided tissue regeneration (GTR), laterally positioned flap, and free gingival

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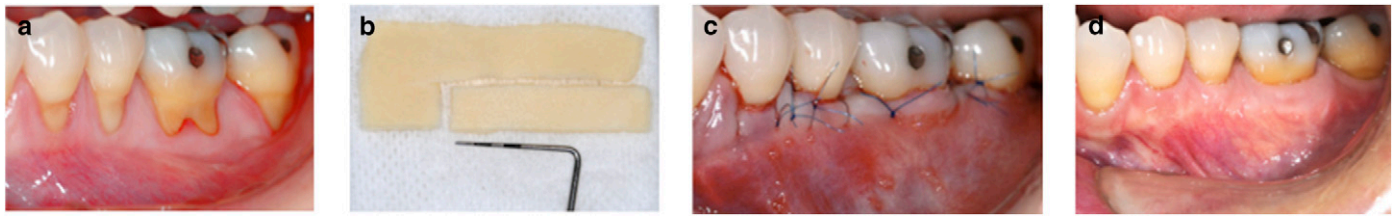

FIGURE 11a Initial presentation of mandibular Miller Class I and II GR defects on posterior teeth. **11b** ADMG measured to defect dimensions. **11c** CAF sutured. **11d** Stable clinical outcome at the 7-year follow-up.

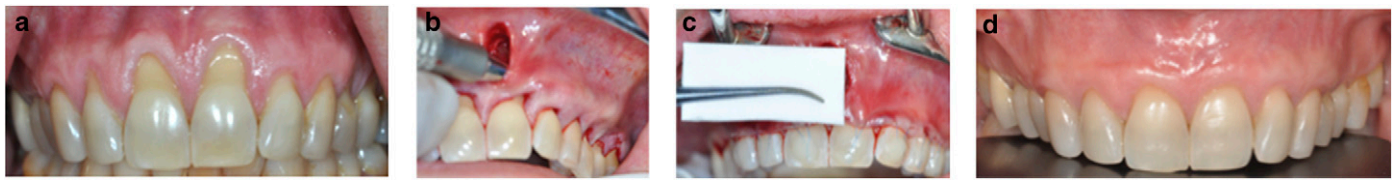

FIGURE 12a Initial presentation of maxillary anterior Miller Class I and II GR defects. **12b** Tunneling procedure using anterior vertical access window. **12c** Collagen matrix placed into prepared tunnel. **12d** Clinical outcome at the 3-year follow-up.

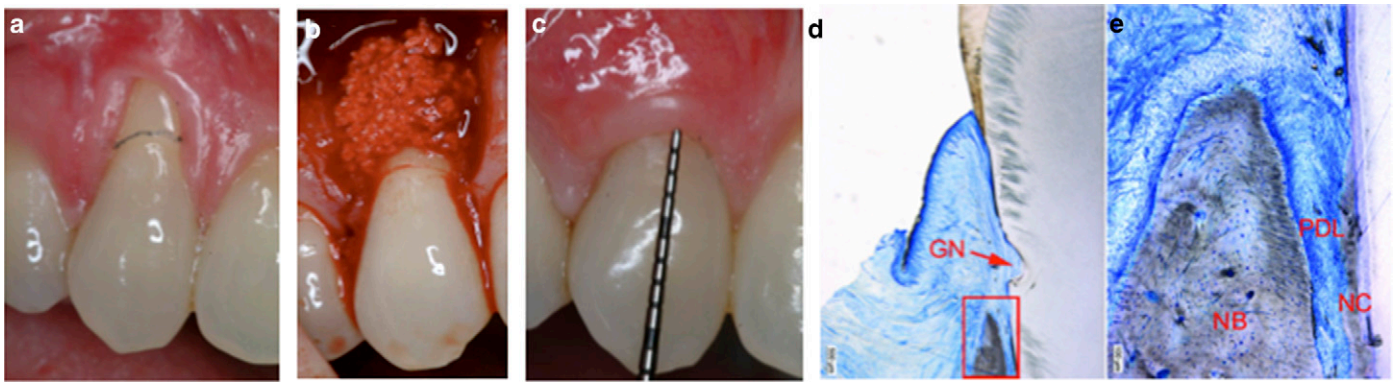

FIGURE 13a Initial presentation of maxillary Miller Class II defects. CEJ position delineated for measurements. **13b** PDGF/β-tricalcium phosphate mixture placed. **13c** Clinical outcome at the 12-month follow-up. **13d** Histology: a well-defined periodontal ligament (PDL) space is seen in this low-power view of a test site just apical to the gingival reference notch (GN) (Toluidine blue & Pyronine G; original magnification 500μm). **13e** Histology: at higher power, perpendicularly oriented CT fibers are seen inserting into newly regenerated bone (NB) and cellular cementum (NC) (Toluidine blue & Pyronine G; original magnification 100μm). Figures 13d and 13e reproduced with permission from Quintessence (McGuire at al.[19]).

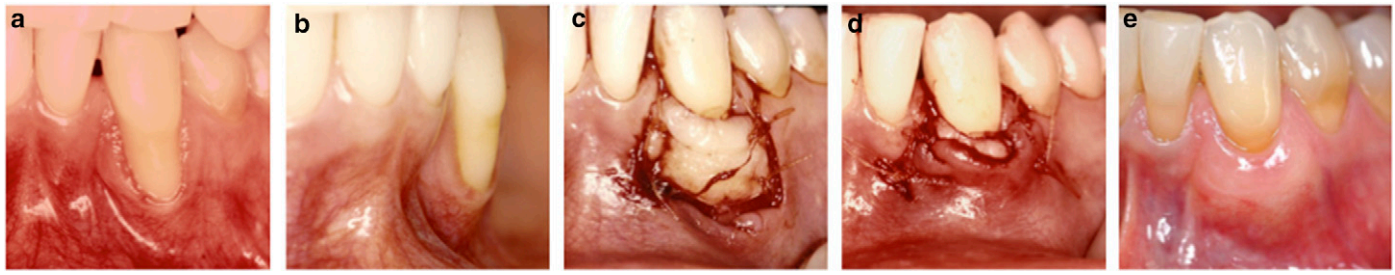

FIGURE 14a Initial presentation of severe mandibular Miller Class III GR defects. **14b** Lateral view. Note the root prominence. **14c** Flap elevated and SCTG sutured. **14d** CAF sutured. **14e** Stable clinical outcome at the 17-year follow-up.

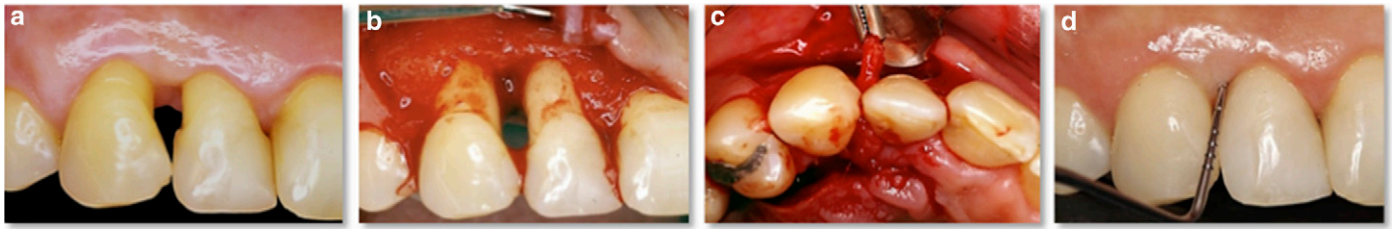

FIGURE 15a Initial presentation of maxillary Miller Class IV GR defects. **15b** Split-thickness flap elevated. Note the interdental bone loss. **15c** Palatal subepithelial pedicle graft pulled interproximally. **15d** Clinical outcome at the 24-month follow-up. Figures 15a through 15d reproduced with permission from Quintessence (De Castro Pinto et al.[24]).

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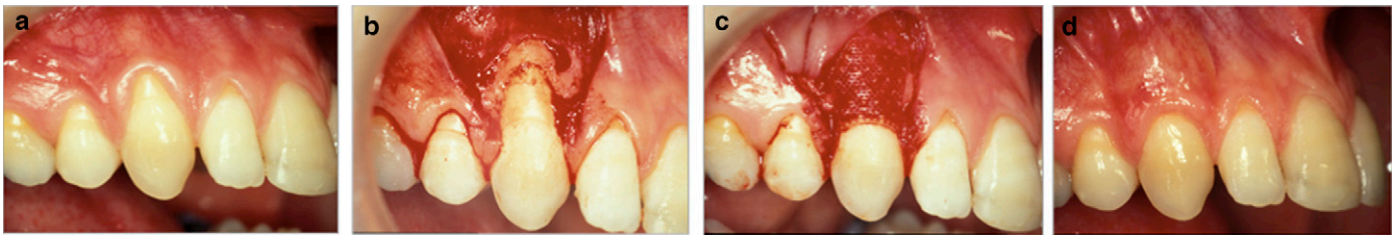

FIGURE 16a Initial presentation of maxillary Miller Class I GR defects. **16b** Split-thickness flap elevated. **16c** GTR procedure with polylactic acid resorbable barrier. **16d** Clinical outcome at the 6-month follow-up.

graft. Enamel matrix derivative (EMD) + CAF is also an interesting and safe approach superior to the use of CAF alone, despite the additional costs related to biomaterials (Figs. 11 through 13).[14-16] It is expected that root coverage procedures will provide CAL gain accompanied by normal probing depths. The wound healing of root coverage procedures will, for the most part, result in formation of a long junctional epithelium and CT attachment with fibers parallel to the root surface. Some degree of tissue regeneration may occur, mainly with procedures incorporating EMD and GTR techniques.[17,18] In 2009, McGuire et al.[19] published findings of human histology which demonstrated true periodontal regeneration including bone, cementum, and periodontal ligament through the use of platelet-derived growth factor-BB (PDGF-BB) in combination with tricalcium phosphate and CAF in the treatment of GR (Fig. 13). Because the majority of the publications included in the systematic review[3] evaluated single-tooth GR sites, the decision tree is better designed for determining appropriate treatment for single-tooth sites, but it may guide the treatment of multiple-tooth GR defects as well. The use of root surface modification agents is not associated with either positive or negative clinical outcomes.

Discussion

The presented cases illustrate the use of different root coverage procedures to treat a variety of GR defects. The selected cases highlight the long-term stability (Fig. 14) of the achieved root coverage and the esthetic benefits of the obtained clinical outcome (Figs. 15 and 16).

Whether measuring CRC, mean root coverage, or increased keratinized tissue (KT), the scientific literature supports the use of SCTGs to treat Miller Class I and II single-tooth GR defects (Fig. 17; Video 1).

In addition, strong evidence supports the use of ADMG or EMD in conjunction with CAFs as an alternative for the management of this classification of GR defect. Multiple-tooth GR defects have not been evaluated as extensively from a research perspective; even so, root coverage procedures appear to be effective. Nevertheless, additional evidence is needed from future studies. For Miller Class III GR defects, SCTG procedures provide significant benefits, but limited evidence supports this conclusion. Additionally, EMD + CAF, ADMG + CAF, and GTR + CAF may also be used, but only limited data exist to support these modes of therapy. With regard to Miller Class IV GR defects, the limited existing evidence suggests that these defects may be improved, but outcomes cannot be predicted.

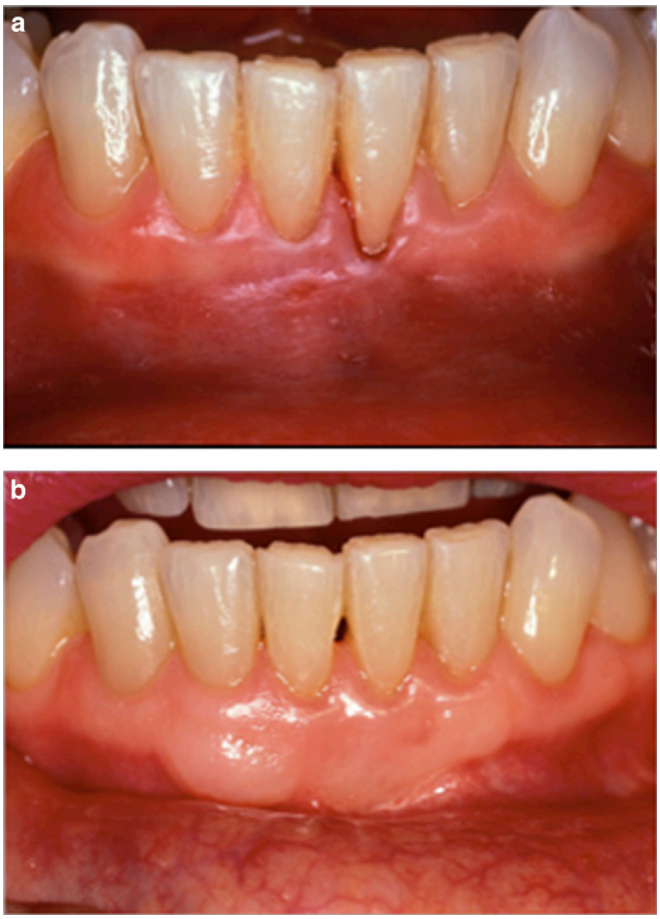

FIGURE 17a Initial presentation of mandibular Miller Class I GR defects. **17b** Presentation of free gingival graft 4 years after surgery.

From a surgical standpoint, the choice of a split- or full-thickness flap or tunnel technique should be based on the goal of maintaining an excellent vascular supply to the flap, which will help revascularize the graft. It appears that, in those grafting procedures in which the flap was sutured coronal to the CEJ, CRC outcomes were attained most consistently.[20]

Finally, with respect to the long-term outcomes that may be expected in private practice, it seems possible to anticipate a mean 70% root coverage ≥2 years after treatment.[21-23] There is a marked variation in the amount of root coverage achieved in different studies (25% to 92.5%), but SCTG-based procedures provided the best and more stable outcomes, whereas CAF alone may be associated with the greatest amount of apical relapse of the gingival margin position over time.[3,20]

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Conclusions

Root-coverage procedures can provide significant reduction in GR depth for most defects and patients. SCTG procedures provide the best outcomes for mean root coverage and CRC, as well as an increase in KT. Additionally, biomaterials, such as ADMG and EMD, in conjunction with CAFs may be used as an alternative to autogenous donor tissue when necessary or desired. The use of PDGF-BB and collagen matrix is also supported, albeit by limited evidence. However, as with all surgical procedures, individual outcomes are influenced by patient- and site-specific risk factors. ■

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