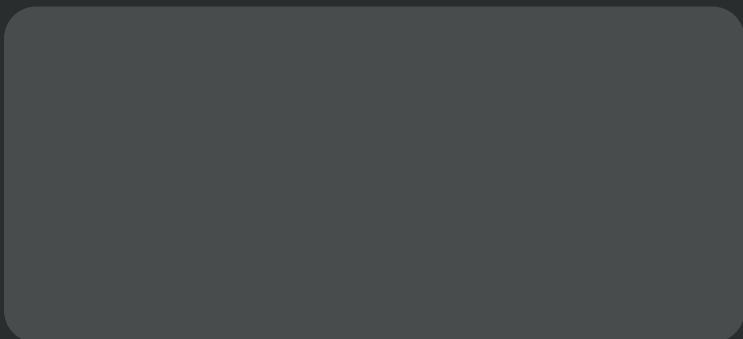




© Roman Zaiets | Dreamstime.com

# Stick to your gums! Platelet concentrates and soft-tissue grafting

A peer-reviewed article written by Maria L. Geisinger, DDS, MS, and Jennifer H. Doobrow, DMD



PUBLICATION DATE:	OCTOBER 2021
EXPIRATION DATE:	SEPTEMBER 2024

EARN  
**3 CE**  
CREDITS

# Stick to your gums! Platelet concentrates and soft-tissue grafting

## Abstract

Gingival recession is a prevalent oral condition and can result in esthetic compromise, dentinal hypersensitivity (DH), and an increase in radicular caries rates. Thin periodontal phenotype is a common predisposing factor for gingival recession and many surgical interventions aim to both achieve root coverage and alter the periodontal phenotype through soft-tissue grafting. While many of these grafting procedures are predictable in improving soft-tissue quality and quantity around teeth and dental implants, patients often complain of discomfort at both the donor and recipient sites. Free gingival grafts (FGGs) and coronally advanced flaps (CAF) alone or in combination with subepithelial connective tissue graft (sCTG) and/or acellular dermal matrix (ADM) are among the most common surgical procedures employed to achieve root coverage and enhance periodontal phenotype. Platelet concentrates (PCs) have been used to improve the outcomes of soft-tissue grafting and postoperative morbidity. PCs contain platelets, growth factors, leukocytes, and stem cells that contribute to cell mitosis, collagen production, and angiogenesis, leading to healing and regeneration of hard and soft tissue. While data continue to emerge on the effects of PCs on the outcomes of soft-tissue grafting, there is a keen interest in the utilization of autologous products to enhance clinical outcomes. This course seeks to explore the biological and physiological properties, as well as the clinical characteristics of PCs that contribute to their role in wound healing and application to periodontal soft-tissue grafting.

## Educational objectives

Upon completion of this course, the dental professional should be able to:

1. Understand the prevalence, etiology, and treatment options for gingival recession.
2. Discuss the applications of platelet concentrates for enhancing the outcomes of soft-tissue grafting procedures.
3. Select the appropriate preparation protocol to achieve good and predictable results utilizing soft-tissue grafting and platelet concentrates.
4. Evaluate the gaps in our current scientific knowledge regarding platelet concentrates and soft-tissue grafting procedures.



Dental Academy of Continuing Education™

Go online to take this course.  
**DentalAcademyofCE.com**

**QUICK ACCESS code 21010**

This continuing education (CE) activity was developed by Endeavor Business Media with no commercial support.

This course was written for dentists, dental hygienists, and dental assistants, from novice to skilled.

**Educational methods:** This course is a self-instructional journal and web activity.

**Provider disclosure:** Endeavor Business Media neither has a leadership position nor a commercial interest in any products or services discussed or shared in this educational activity. No manufacturer or third party had any input in the development of the course content.

**Requirements for successful completion:** To obtain three (3) CE credits for this educational activity, you must pay the required fee, review the material, complete the course evaluation, and obtain an exam score of 70% or higher.

**CE planner disclosure:** Laura Winfield, Endeavor Business Media dental group CE coordinator, neither has a leadership nor commercial interest with the products or services discussed in this educational activity. Ms. Winfield can be reached at [lwinfield@endeavorb2b.com](mailto:lwinfield@endeavorb2b.com).

**Educational disclaimer:** Completing a single continuing education course does not provide enough information to result in the participant being an expert in the field related to the course topic. It is a combination of many educational courses and clinical experience that allows the participant to develop skills and expertise.

**Image authenticity statement:** The images in this educational activity have not been altered.

**Scientific integrity statement:** Information shared in this CE course is developed from clinical research and represents the most current information available from evidence-based dentistry.

**Known benefits and limitations of the data:** The information presented in this educational activity is derived from the data and information contained in the reference section.

**Registration:** Rates for print CE have increased due to the manual nature of producing and grading courses in this format. For a lower-cost option, scan the QR code or go to [dentalacademyofce.com](http://dentalacademyofce.com) to take this course online. **MAIL/FAX:** \$69 for three (3) CE credits. **DIGITAL:** \$59 for three (3) CE credits.

**Cancellation and refund policy:** Any participant who is not 100% satisfied with this course can request a full refund by contacting Endeavor Business Media in writing.

### Provider information:

Dental Board of California: Provider RP5933. Course registration number CA code: 03-5933-21010. Expires 7/31/2022.  
\*This course meets the Dental Board of California's requirements for three (3) units of continuing education.\*



Endeavor Business Media is a nationally approved PACE program provider for FAGD/MAGD credit. Approval does not imply acceptance by any regulatory authority or AGD endorsement.  
11/1/2019 to 10/31/2022.  
Provider ID# 320452  
AGD code: 490



American Academy of Dental Hygiene  
Approved provider through December 31, 2021

Endeavor Business Media is designated as an approved Provider by the American Academy of Dental Hygiene, Inc. #AADHPNW (January 1, 2021-December 31, 2022). Approval does not imply acceptance by a state or provincial Board of Dentistry. Licensee should maintain this document in the event of an audit.

### ADA CERP®

Continuing Education Recognition Program

Endeavor Business Media is an ADA CERP-recognized provider.

ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of dental continuing education. ADA CERP does not approve or endorse individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry.

Concerns or complaints about a CE provider may be directed to the provider or to ADA CERP at [ada.org/cerp](http://ada.org/cerp).



## Introduction

Gingival recession and its ideal treatment present concerns for patients and practitioners alike. Root exposure associated with gingival recession can cause esthetic compromise, increased rates of radicular caries, and/or dentinal hypersensitivity.<sup>1</sup> The incidence of gingival recession is linked to periodontal phenotype, tooth position/prominence, gingival trauma, and periodontitis.<sup>2</sup> Many treatment modalities exist to improve root coverage with free gingival graft (FGG), coronally advanced flap with subepithelial connective tissue graft (CAF + sCTG), and CAF with acellular dermal matrix (CAF + ADM) being the most common techniques employed.<sup>3-5</sup> These techniques may face patient resistance, however, due to fear of postoperative bleeding and/or other concerns centered around perioperative surgical complications. To combat these concerns and increase patient acceptance, a number of alternative surgical approaches including the use of microsurgical techniques, adjunctive growth factor, alternative graft materials, and enhanced surgical approaches have been considered.

Platelet concentrates (PCs) are derived from autogenous blood, and the biomaterials are obtained through centrifugation. These materials include first-generation PCs, including platelet-rich plasma (PRP), and second-generation PCs, including leukocyte-rich platelet-rich fibrin (L-PRF).<sup>6</sup> Furthermore, alterations in preparation protocols and additions of bioactive materials have led to emerging forms of platelet-rich fibrins that may have advantages in particular clinical scenarios.<sup>6</sup> While differences exist in the preparation and clinical properties of PCs, namely the use of coagulant in the preparation of PRP and the different handling capabilities of various PCs, all of these materials have commonalities. These patient-derived materials require venipuncture and blood draw, but allow for high levels of accessibility and patient acceptance, which has led to an increase in their use as adjuncts during soft- and hard-tissue grafting in dentistry. The centrifugation process produces materials with increased concentrations of

the growth factors and cytokines that are critical to wound healing and repair. Additionally, the handling capabilities of these are based upon their biological scaffolds that may stabilize and allow release of these blood-derived biomarkers including: platelet-derived growth factor (PDGF), transforming growth factor- $\beta$  (TGF- $\beta$ ), bone morphogenetic protein-2 (BMP-2), vascular endothelial growth factor (VEGF), and others.<sup>7,8</sup> The preparation protocols for various PCs have been described in detail in our last publication,<sup>9</sup> and it is important to understand the underlying preparation and how the resultant PCs differ in applications and contents so that the correct preparation can be utilized based upon the patient and clinical conditions.

## Ideal components of materials to regenerate missing soft tissues What are mucogingival deformities?

The American Academy of Periodontology's glossary of terms defines a mucogingival deformity as "a departure from the normal dimension and morphology of, and/or interrelationship between gingiva and alveolar mucosa; the abnormality may be associated with a deformity of the underlying alveolar bone."<sup>10</sup> Mucogingival deformities include gingival recession, lack of keratinized and/or attached gingiva, decreased vestibular depth, and aberrant frenum/muscle position.<sup>11</sup> Periodontal phenotype and lack of keratinized tissue are considered predisposing factors for the development of gingival recession and inflammation and are often treated around teeth and implants to improve long-term outcomes.<sup>12-15</sup>

The success of treatments for gingival recession are influenced by a number of clinical characteristics, most importantly: 1) recession depths, 2) gingival thickness, and 3) interdental clinical attachment level (CAL).<sup>11</sup> Increased recession depth is associated with a decreased possibility for complete root coverage, and this should be assessed preoperatively by measuring the distance from the cemento-enamel junction (CEJ) and/or its reconstruction if it has been obliterated with lost hard tissue and the gingival margin.<sup>16</sup> Gingival thickness of less than 1 mm is associated with

reduced root coverage in procedures that utilize coronally advanced flaps without additional soft-tissue graft materials.<sup>17,18</sup> Gingival thickness may be assessed by observing metal show-through of a probe inserted into the gingival sulcus. If this show-through is visible, the gingival thickness is generally <1 mm.<sup>19,20</sup> Root coverage procedures and their predicted outcomes are dependent upon intact interdental attachment, and loss of interdental attachment is associated with lack of complete root coverage.<sup>21,22</sup>

In order to make predictions about the likely success of root coverage procedures, classification systems have been proposed to outline various recession types that can be related to higher or lower predictability of root coverage<sup>23</sup> and may help inform the selection of treatment modalities, including the potential use of adjunctive growth factors or PCs (table 1). This classification from Cairo and colleagues assesses the clinical presentation and interproximal bone levels to better predict treatment outcomes.<sup>23</sup> For example, complete root coverage may be expected when recession type 1 (RT1) defects are treated with traditional root coverage approaches, and partial/no root coverage is expected for RT2-RT3 defects.<sup>23</sup> This may be helpful when assessing cases that may benefit from adjunctive growth factors and/or PCs as systematic reviews suggest that use of growth factors may improve root coverage outcomes at gingival recession sites when interdental bone loss is present.<sup>24</sup>

## What types of cells participate in the wound healing process during soft-tissue grafting?

Overall, soft tissue at sites of wound healing follow similar patterns, and the phenotypic expression at the healed sites are a function of the origin of the native and transplanted tissues at those sites, rather than determined by functional stresses.<sup>25</sup> That is, donor tissue from a site of keratinized mucosa will result in a keratinized phenotype at the recipient site.<sup>26</sup> The presence and proliferation of fibroblasts, epithelial cells, and endothelial cells generally characterize normal wound healing, including the formation of immature

**TABLE 1: Root coverage classification and expected treatment outcomes.<sup>11,23</sup>**

Cairo recession type classification	Description of recession defects	Expected treatment outcomes
RT1	Gingival recession without interproximal attachment loss. Interproximal CEJ is not clinically detectable at both mesial and distal aspects of the tooth.	Complete root coverage can be expected with standard surgical techniques.
RT2	Gingival recession associated with loss of interproximal attachment, but the interproximal attachment loss is coronal to or equal to the buccal attachment loss.	Partial root coverage can be expected with standard surgical techniques.
RT3	Gingival recession associated with loss of interproximal attachment, and interproximal attachment loss is more apical than the buccal attachment loss.	Root coverage may not be anticipated, but soft-tissue grafting may still be warranted to alter periodontal phenotype.

fibrovascular tissue (i.e., granulation tissue) containing fibroblasts, collagen, and blood vessels that precedes mature angiogenesis.<sup>27-29</sup> At sites that are treated using graft materials, healing differs based upon the type of graft material and the preparation of the recipient bed. Autogenous grafts generally survive initially with plasmatic circulation, and both angiogenesis and anastomosis of existing capillaries occur early in healing to allow for reestablishment of blood supply to the graft.<sup>30-32</sup> In allogeneic graft materials, such as acellular dermal matrix, preparation of the graft materials may alter their degradation time frame, but these materials generally serve as a scaffold for new blood vessels, fibroblasts, myofibroblasts, and other cells to repopulate.<sup>33,34</sup>

#### What are the effects of platelet concentrates on cells associated with soft-tissue regeneration?

Growth factors released by platelet concentrates play an important role in wound healing.<sup>7,8</sup> PCs, specifically PRF, have demonstrated an upregulation of periodontal ligament fibroblasts (PDL-F), gingival fibroblasts (GF), and osteoblast proliferation, indicating that these biomaterials may speed up healing and/or improve early healing outcomes.<sup>35</sup> Furthermore, PCs may have antimicrobial properties: PRP and PRF were both shown to inhibit bacterial growth of *P. gingivalis* and *A.*

*actinomycetemcomitans* for more than 24 hours in vitro.<sup>36</sup> This antimicrobial function could be important in preventing adverse healing outcomes of soft-tissue grafting, particularly if allograft and/or xenograft materials are used for soft-tissue augmentation. Finally, it has been suggested that PRP may suppress long-term expression of pro-inflammatory cytokines and reduce chronic inflammation, which could lead to longer-term stability of some of these soft-tissue grafts, which have demonstrated a propensity for relapse.<sup>37</sup>

#### Regenerative techniques for soft-tissue grafting

Gingival augmentation around natural teeth and implants have been proposed to achieve root coverage, improve esthetics, reduce dentinal hypersensitivity (DH), facilitate improved patient-delivered plaque control, and/or prevent future recession and attachment loss.<sup>4,5,38</sup> Given the myriad rationales for employing soft-tissue grafting procedures, the techniques that may predictably improve clinical outcomes are briefly reviewed.

#### What techniques are available to achieve root coverage?

Many treatment options are currently in use to achieve root coverage at sites of gingival recession. sCTG used in combination with CAF is generally considered the gold standard for improving both root

coverage and width of keratinized tissue, but its utility may be limited in certain individuals based upon anatomic considerations at the donor site and patient preference to limit the number of surgical sites and interventions.<sup>4,5,38</sup> Given these concerns, it is imperative that practitioners understand the full armamentarium of procedures that can produce acceptable results and the underlying scientific evidence for the predictability of such procedures in individual clinical scenarios. Options for surgical treatment of gingival recession include:

#### 1) Coronally repositioned flap without placement of a graft

This procedure may achieve root coverage in patients with a thick periodontal phenotype, but its utility may be limited at sites with thin overlying gingival tissue. Furthermore, this technique has been shown to be enhanced by the application of enamel matrix derivatives (EMD) and recombinant human platelet derived growth factor (rhPDGF-BB) and has resulted in enhanced patient-centered outcomes in those patients.<sup>38-40</sup>

#### 2) Autogenous free gingival graft (FGG) placement

FGGs were initially proposed as a mechanism to treat gingival recession defects in 1957 by Friedman.<sup>41</sup> While they demonstrate marked increases in width of keratinized and attached gingiva post-operatively, they have demonstrated less predictable complete root coverage when compared to CAF + sCTG.<sup>42</sup> Additionally, they often heal with a color discrepancy with the surrounding gingival tissues, which may not allow for their use in esthetic areas.

#### 3) Coronally advanced flap (CAF) with subepithelial connective tissue graft (sCTG)

sCTG and CAF are generally considered the gold standard for root coverage procedures, but a secondary surgical site and site-specific limitations may reduce patient acceptance of these procedures.<sup>38-40,42</sup> As with any autogenous tissue, there is a limit to the quantity of tissue that may be harvested at one time due to underlying anatomical structures.<sup>4</sup>

As such, multiple recession defects may require multiple surgeries with periods of healing in between. It is also of note that connective tissue density may vary based upon the harvesting technique and where in the palate the tissue is harvested, and this may affect clinical outcomes as well.<sup>43,44</sup>

#### 4) Coronally advanced flap (CAF) with acellular dermal matrix (ADM)

Allogeneic grafts have demonstrated an ability to achieve predictable root coverage, particularly at sites without interproximal bone loss (e.g., Cairo RT1), but these techniques demonstrate significantly less increase in keratinized gingiva than CAF and sCTG.<sup>5</sup> While some publications suggest that CAF + ADM can increase attached tissue, deepen the vestibule, and stabilize sites postoperatively,<sup>45,46</sup> heterogenous data exist about the recurrence of recession at sites treated with CAF and ADM. This tissue may have an advantage of avoiding a secondary surgical site and allowing for the treatment of multiple recession defects at one time.<sup>45</sup> Conversely, patients may present with an objection to use of human donor tissue, which could be a barrier to use of an allograft product.

#### 5) Xenogenic matrices

Porcine and bovine collagen matrices have been used as replacement grafts, and while increases in keratinized tissue have been seen, root coverage appears to be less than seen with CAF + CTG, CAF + ADM, or CAF + EMD.<sup>47-51</sup> Patient-reported outcomes were analyzed compared with control treatment using autogenous grafts demonstrating significant pain reduction, less analgesic drug consumption, and better patient acceptance.<sup>47-51</sup>

#### 6) Living cellular constructs

These grafts represent bioengineered, cell-embedded constructs composed of living allogeneic human fibroblasts and keratinocytes, bovine collagen, and human extracellular proteins. It has been shown to be safe and effective in increasing KT in randomized controlled trials and further research is necessary to identify ideal applications.<sup>52,53</sup>

#### What techniques are available to alter periodontal phenotype?

The term *periodontal phenotype* refers to the bone and gingival characteristics, including keratinized tissue and bone and gingival thickness.<sup>54</sup> While the bone morphology can only be assessed via CBCT, the gingival phenotype can be assessed clinically with minimally invasive techniques, such as probe visibility in the sulcus and bone sounding.<sup>19,54</sup> The presence of a thin periodontal phenotype has been associated with a greater risk for developing gingival recession over a patient's lifetime and also as a consequence of specific dental therapies, including restorative and orthodontic therapies.<sup>55,56</sup> Current evidence suggests that at deficient zones of keratinized mucosal width (< 2 mm), the likelihood of patient discomfort and sub-optimal plaque control increases along with the probability of developing marginal bone loss and bleeding on probing.<sup>56</sup> Recent meta-analyses have assessed the ability of treatment options to alter the periodontal phenotype around teeth and implants. Many treatment options are currently in use to alter periodontal phenotype with clinical success.<sup>13,57</sup> For example, sCTG used in combination with CAF and/or FGG are generally considered the gold standards in cases where periodontal phenotype needs alterations, but limitations of autogenous tissue use may limit patient acceptance of such care.<sup>13,57</sup> Additional treatments including the use of ADM, CAF + EMD, and xenograft matrices may provide adequate gain in KT and increases in tissue thickness and stability that can alter periodontal phenotype to clinically acceptable levels.<sup>12, 46,57</sup>

#### How can adjunctive materials improve outcomes?

Various surgical techniques have been used to address gingival recession and to increase width of keratinized tissue and gingival tissue thickness. Free gingival grafts, coronally advanced flaps (CAF), laterally positioned flaps, sCTGs, and acellular dermal matrix (ADM) with CAF have all demonstrated efficacy in improving recession defects and their sequelae. However, most studies have been performed on recession defects where one would expect

complete root coverage, e.g., Cairo RT1 recession defects.<sup>3-5</sup> At sites with more complex clinical presentations, such as Cairo RT2 and RT3 defects, and in patients with other complicating factors, such as smoking or diabetes mellitus, the adjunctive addition of growth factors and other biologic mediators, including PCs, has been proposed to improve root coverage, gingival tissue quantity/quality, and post-operative patient comfort.<sup>24,58-60</sup>

For example, the addition of EMD to ADM demonstrated increased mean root coverage (55.4% in the test group and 44.0% in the control group;  $p < 0.04$ ) and increased percentage of complete root coverage (complete root coverage achieved in three test sites and one control site;  $p < 0.02$ ) in smokers when compared with ADM alone.<sup>58</sup> Furthermore, the addition of growth factors to periodontal plastic surgery techniques has been shown to improve both mean root coverage and percentage of complete root coverage less complex defects.<sup>5,24,61,62</sup> As the evidence suggests that the addition of adjunctive growth factors may improve wound healing and clinical outcomes,<sup>5,24</sup> a search for an adjunctive material that allows for delivery of growth factors to improve wound healing and a comparison and critical evaluation of currently used growth factors is warranted in future research. Advantages of PCs for this type of application are that they are autologous, readily harvested on the day of surgery, and may contain a combination of growth factors in physiologic ratios that may provide benefits during periodontal plastic surgical procedures. Furthermore, PCs have been shown to increase tissue maturation during post-operative healing when used as adjunctive materials with grafting.<sup>63</sup>

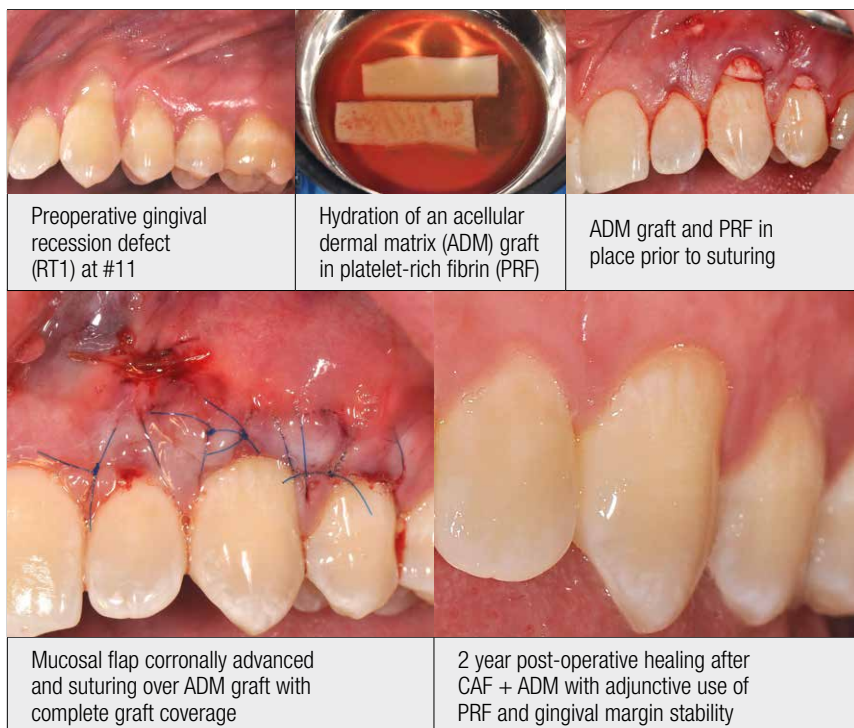
#### Review of platelet concentrates in soft-tissue grafting

It is well established that platelets play a critical role in hemostasis and healing. They are also a robust source of growth factors. Briefly, platelets' alpha granules contain platelet-derived growth factor (PDGF), vascular endothelial factor (VEGF), insulin-like growth factor

(IGF), and transforming growth factor-beta (TGF-  $\beta$ ).<sup>64,65</sup> Due to the presence of these growth factors and the high rate of patient acceptance of autologous materials, PCs have been widely used in dental procedures to aid in postoperative wound healing.<sup>66,67</sup> While we have previously reviewed the role of PCs in hard-tissue reconstruction in dentistry,<sup>9</sup> these biomaterials may have a role in soft-tissue grafting as well (figure 1).

treated with root coverage procedures and adjunctive PC use have also been shown to demonstrate superior gingiva index and an increase in gingival thickness as compared to such procedures without PCs.<sup>69</sup> Additionally, techniques using minimally invasive dental surgery and application of autologous PCs have been proposed as novel root coverage procedures for individuals with RT1 deficiencies.<sup>70,71</sup> In addition to the benefits for

healing at autologous graft donor sites. The use of PRF as a biologic bandage at palatal donor sites after harvest of CTG or FGG grafts may provide faster healing at those sites and lead to less morbidity and higher levels of patient acceptance for these therapies.<sup>74</sup> Furthermore, novel therapies including the use of microneedling and injectable PCs have been adapted from dermatologic and plastic surgery applications as methods to increase gingival thickness over time and thus alter periodontal phenotype.<sup>75</sup>



**FIGURE 1:** Root coverage procedure with CAF + ADM and adjunctive use of PC prior to graft placement

### Clinical indications of platelet concentrates for root coverage

The use of PCs to improve outcomes of soft-tissue procedures is particularly appealing as it allows for use of an autogenous material to enhance wound stability, postoperative healing, and clinical outcomes. Furthermore, it has been proposed that the use of PCs may allow for grafting in some cases without the use of gingival substitute graft materials, thereby reducing treatment time and postoperative morbidity. Application of PCs during soft-tissue grafting results in greater postoperative root coverage with coronally advanced flap (CAF), but not CAF and connective tissue graft (CTG).<sup>62,68</sup> Sites

clinical outcomes that PCs may provide during soft-tissue grafting, it has also been proposed that PCs may improve postoperative pain control and patient-reported outcomes during the healing phase.<sup>72,73</sup> These improvements have been attributed to the more rapid healing progression attributed to PC application.<sup>72,73</sup>

### Clinical indications of platelet concentrates for other soft-tissue grafting procedures

While much attention has been paid to the potential benefits of PCs at soft-tissue graft recipient sites, PCs have shown promise as a method to decrease patient discomfort and encourage blood clot stabilization and

### Advances in platelet concentrates for soft-tissue grafting

While first- and second-generation PCs demonstrate different applications and utility for applications in dental surgery,<sup>9</sup> further advances in PC technology have led to the emergence of so-called “third generation PCs,” namely, T-PRF, A-PRF, i-PRF, and C-PRF.<sup>76,77</sup> The evolution of PCs for various applications has allowed for more targeted selection of materials based upon the patient’s individual needs and the clinical defects that are being treated. Each of these advanced PCs represents an alteration in the preparation process to produce a specialized biomaterial (table 2). These tissues may be utilized for individual procedures that first- and/or second-generation PCs may not be ideally suited for, such as injectable PRF for minimally invasive therapies and targeted gingival enhancements.<sup>75</sup>

### Conclusion

Platelet concentrates are emerging as a widely available and highly patient-acceptable biomaterial to aid in hard- and soft-tissue regeneration. The adjunctive use of PCs during soft-tissue grafting procedures may provide distinct benefits during periodontal plastic surgery procedures aimed at increasing root coverage and altering the periodontal phenotype. Additionally, the use of such materials in cases where patient and/or site-specific factors are likely to result in less predictable outcomes may provide increased likelihood of beneficial clinical results. Further, the potent growth factors contained in PCs may allow for decreased healing time and patient-perceived postoperative discomfort, thus increasing patient

**TABLE 2: Currently available platelet concentrates and proposed ideal applications in soft-tissue grafting.** <sup>68-79</sup>

Platelet concentrate type	Preparation	Growth factor release	Intra-operative handling	Clinical applications
Platelet-rich plasma (PRP)	Increased preparation time (>30 minutes) with multiple centrifugation steps Requires the use of bovine thrombin/calcium chloride	Rapid release of growth factors over shorter period of time	PRP should be used within 4 hours after preparation for optimum results. End product is a liquid or weak gel and cannot be formed into a clot or membrane.	PRP has shown enhanced root coverage when used in combination with CAF compared to CAF alone. Liquid PRP may be used to hydrate acellular dermal matrices or xenograft matrices or can be applied after suturing to wound surfaces to aid in soft tissue.
Leukocyte-rich platelet-rich fibrin (L-PRF)	Rapid preparation process (<15 minutes) with single-step centrifugation No requirement for additional external additives	Gradual release of growth factors for up to 7-14 days Enhanced protocols, including heat treatment of the clot, may extend growth factor release and structural integrity.	Fibrin clot enables better handling properties. Handling, blood collection, transfer time to centrifuge are critical for ultimate results. PRF volume is dependent upon the volume of blood drawn and natural polymerization process.	L-PRF has been shown to enhance root coverage outcomes when used with CAF compared to CAF alone. May be used as a biologic bandage to reduce patient discomfort during early wound healing.
Titanium prepared platelet-rich fibrin (T-PRF)	After blood is collected, it is prepared and centrifuged using titanium vials (rather than glass) and a single-step centrifugation process.	May demonstrate more polymerized and therefore thicker fibrin network than other L-PRF prepared in glass vials	Increased structural integrity could lead to longer stability in vivo and improved handling capabilities, but further study is needed.	No current data are available.
Advanced platelet-rich fibrin (A-PRF)	After blood draw, A-PRF is prepared using a lower centrifugation speed for a longer period of time than L-PRF (i.e., 1500 rpm, 14 mins).	Microscopy studies demonstrate increased presence of neutrophilic granulocytes in the distal portion of the clot. These neutrophilic granulocytes are critical in the induction of differentiation of macrophages within the clot and surrounding tissues.	Increased macrophage differentiation could lead to increased regenerative cell recruitment, but further study is needed.	No current data are available.
Injectable platelet-rich fibrin (i-PRF)	i-PRF is prepared using lower centrifugation speeds for a relatively short time period (i.e., 700 rpm for 3 mins).	i-PRF has been shown to release growth factors for up to 10 days and demonstrated increased expression of TGF- $\beta$ , PDGF, and collagen type 1 when compared to other PCFs.	i-PRF is liquid and has been proposed as an injectable material with both surgical interventions and microneedling procedures for soft-tissue augmentation. The liquid nature of the material may make it more desirable for minimally invasive procedures, but can limit applications that require more structural integrity.	While case reports and case series report success using i-PRF for both root coverage and periodontal phenotype alterations, long-term RCTs are necessary to determine the comparative effectiveness.
Concentrated platelet-rich fibrin (C-PRF)	The liquid PRF directly collected from the buffy-coat layer after L-PRF preparation protocols is considered concentrated PRF (C-PRF).	C-PRF demonstrates up to a 10-fold increase in platelet and leukocyte yields over whole blood samples and a 3-5-fold increase in platelet numbers are seen in other PRF preparations.	This material is a liquid and is limited in volume that may be harvested (0.3-0.5 mL), thus potentially limiting its handling and applications.	No data are currently available.

satisfaction and treatment acceptance. Lastly, the emergence of third-generation PCs for more specific clinical indications may allow for enhanced personalized care with regard to soft-tissue grafting and postoperative wound healing. It is important to note that future randomized controlled trials comparing standard soft-tissue grafting procedures with and without the adjunctive use of PCs and comparing adjunctive PC use with other growth factors as well as standardization of harvest and preparation protocols are needed to allow practitioners to identify the ideal treatment options for individual patient needs.

## References

- Bouchard P, Malet J, Borghetti A. Decision making in aesthetics: root coverage revisited. *Periodontol* 2000. 2001;27:97-120.
- Kassab MM, Cohen RE. The etiology and prevalence of gingival recession. *J Am Dent Assoc*. 2003;134:220-225.
- Richardson CR, Allen EP, Chambrone L, et al. Periodontal soft tissue root coverage procedures: practical applications from the AAP Regeneration Workshop. *Clin Adv Periodontics*. 2015;5(1):2-10.
- Scheyer ET, Sanz M, Dibart S, et al. Periodontal soft tissue root coverage procedures: a consensus report from the AAP Regeneration Workshop. *J Periodontol*. 2015;86(2 Suppl):S73-S76.
- Chambrone L, Tatakis DN. Periodontal soft tissue root coverage procedures: a systematic review from the AAP Regeneration Workshop. *J Periodontol*. 2015;86(2 Suppl):S8-S11.
- Castro AB, Meschi N, Temmerman A, et al. Regenerative potential of leucocyte- and platelet-rich fibrin. Part A: intra-bony defects, furcation defects and periodontal plastic surgery. A systematic review and meta-analysis. *J Clin Periodontol*. 2017;44(1):67-82.
- Dohan DM, Choukroun J, Diss A, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;101(3):e37-44.
- Dohan DM, Choukroun J, Diss A, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2006;101(3):e45-50.
- Doobrow JH, Geisinger ML. Stick with it! Platelet concentrates for bone grafting and periodontal regeneration. Dental Academy of Continuing Education. July 2021. <https://dentalacademyofce.com/dace/coursereview.aspx?url=4452%2FPDF%2F2108CEDdo.pdf&scid=19581>
- American Academy of Periodontology. AAP Glossary of Terms. Mucogingival deformity. Accessed November 16, 2020. <https://members.perio.org/libraries/glossary/entry?GlossaryKey=b0bc9e15-62c8-46c9-b57d-0bac351f411d&ssopc=1>
- Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: narrative review, case definitions, and diagnostic considerations. Proceedings from the 2017 AAP/EFPP World Workshop. *J Periodontol*. 2018;89(Suppl 1):S204-S213.
- Kim DM, Neiva R. Periodontal soft tissue non-root coverage procedures: a systematic review from the AAP regeneration workshop. *J Periodontol*. 2015;86(52):S56-S72.
- Barootchi S, Tavelli L, Zucchelli G, et al. Gingival phenotype modification therapies on natural teeth: a network meta-analysis. *J Periodontol*. 2020;91:1386-1399.
- Lin GH, Curtis DA, Kapila Y, et al. The significance of surgically modifying soft tissue phenotype around fixed dental prostheses: an American Academy of Periodontology best evidence review. *J Periodontol*. 2020;91(3):339-351.
- Kao RT, Curtis DA, Kim DM, et al. American Academy of Periodontology best evidence consensus statement on modifying periodontal phenotype in preparation for orthodontic and restorative treatment. *J Periodontol*. 2020;91(3):289-298.
- Chambrone L, Pannuti CM, Tu YR, Chambrone LA. Evidence-based periodontal plastic surgery. II. An individual data meta-analysis for evaluating factors in achieving complete root coverage. *J Periodontol*. 2012;83:477-490.
- Baldi C, Pini-Prato G, Pugliaro U, et al. Coronally advanced flap procedure for root coverage: Is flap thickness a relevant predictor for root coverage? A 19-case series. *J Periodontol*. 1999;70:1077-1084.
- Hwang D, Wang H-M. Flap thickness as a predictor of root coverage: a systematic review. *J Periodontol*. 2006;77:1625-1634.
- De Rouck T, Eghbali R, Collys K, et al. The gingival biotype revisited: transparency of the periodontal probe through the gingival margin as a method to discriminate thin from thick gingiva. *J Clin Periodontol*. 2009;36:428-433.
- Rasperini G, Acunzo R, Cannalire P, Farronato G. Influence of periodontal biotype on root surface exposure during orthodontic treatment: a preliminary study. *Int J Periodontics Restorative Dent*. 2015;35:665-675.
- Tatakis DN, Chambrone L, Allen EP, et al. Periodontal soft tissue root coverage procedures: a consensus report from the AAP regeneration workshop. *J Periodontol*. 2015;86(52):S52-S55.
- Tonetti MS, Jepsen S. Clinical efficacy of periodontal plastic surgery procedures consensus report of group 2 of the 10<sup>th</sup> European Workshop on Periodontology. *J Clin Periodontol*. 2014;41(S15):S36-S43.
- Cairo F, Nieri M, Cincinelli S, et al. The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. *J Clin Periodontol*. 2011;38:661-666.
- Geisinger ML, Trammell K, Holmes CM, et al. Does adjunctive use of growth factors improve clinical outcomes and/or root coverage in the treatment of Miller Class III recession defects? A review of current evidence. *Clinical Adv in Periodontol*. 2016;6(2):99-103.
- Sculean A, Gruber R, Bosshardt DD. Soft tissue wound healing around teeth and dental implants. *J Clin Periodontol*. 2014;41(Suppl 15):S6-S22.
- Karring T, Lang NP, Löe H. The role of gingival connective tissue in determining epithelial differentiation. *J Periodontol Res*. 1975;10(1):1-11.
- Izumi K, Feinberg SE, Iida A, Yoshizawa M. Intraoral grafting of an ex vivo produced oral mucosa equivalent: a preliminary report. *Int J Oral Maxillofac Surg*. 2003;32:88-197.
- McGuire MK, Nunn ME. Evaluation of the safety and efficacy of periodontal applications of a living tissue-engineered human fibroblast-derived dermal substitute. I. Comparison to the gingival autograft: a randomized controlled pilot study. *J Periodontol*. 2005;76:867-880.
- Morelli T, Neiva R, Nevins ML, et al. Angiogenic biomarkers and healing of living cellular constructs. *J Dent Res*. 2011;90(4):456-462.
- Oliver RC, Löe H, Karring T. Microscopic evaluation of the healing and revascularization of free gingival grafts. *J Periodontol Res*. 1968;3(2):84-95.
- Janson WA, Ruben MP, Kramer GM, et al. Development of the blood supply to split-thickness free gingival autografts. *J Periodontol*. 1969;40:707-716.
- Bohm S, Weng D, Meyle J. Connective tissue grafts in periodontal surgery. *Perio*. 2006;3(2):129-137.
- Boháč M, Danišovič L, et al. What happens to an acellular dermal matrix after implantation in the human body? A histological and electron microscopic study. *Eur J Histochem*. 2018;62(1):2873.
- Vignoletti F, Nunez J, Sanz M. Soft tissue regeneration in the oral cavity: review of the current literature on scaffolds, cells, and biologicals. *J Clin Periodontol*. 2014;41(Suppl 15):S23-S35.
- Tsai C-H, Shen S-Y, Zhao J-H, Chang Y-C. Platelet-rich fibrin modulates cell proliferation of human periodontally related cells in vitro. *J Dent Sci*. 2009;4(3):130-135.
- Yang L-C, Hu S-W, Yan M, et al. Antimicrobial activity of platelet-rich plasma and other plasma preparations against periodontal pathogens. *J Periodontol*. 2015;86(2):310-318.
- El-Sharkawy H, Kantarci A, Deady J, et al. Platelet-rich plasma: growth factors and pro- and anti-inflammatory properties. *J Periodontol*. 2007;78(4):661-669.
- Chambrone L, Chambrone D, Pustigliani FE, et al. Can subepithelial connective tissue grafts be considered the gold standard procedure in the treatment of Miller Class I and II recession-type defects? *J Dent*. 2008;36:659-671.
- Chambrone L, Sukekava F, Araujo MG, et al. Root-coverage procedures for the treatment of localized



- recession-type defects: a Cochrane systematic review. *J Periodontol.* 2010;81:452-478.
40. Cairo F, Pagliaro U, Nieri M. Treatment of gingival recession with coronally advanced flap procedures: a systematic review. *J Clin Periodontol.* 2008;35(Suppl. 8):136-162.
  41. Friedman N. Mucogingival surgery. *Tex Dent J.* 1957;75:358-362.
  42. Paolantonio M, di Murro C, Cattabriga A, Cattabriga M. Subpedicle connective tissue graft. *Periodontol.* 1997;24(1):51-56.
  43. Bertl K, Pifl M, Hirtler L, et al. Relative composition of fibrous connective and fatty/glandular tissue in connective tissue grafts depends on the harvesting technique but not on the donor site of the hard palate. *J Periodontol.* 2015;96(12):1-14.
  44. Amin P, Bissada NF, Ricchetti PA, et al. Tuberosity versus palatal donor sites for soft tissue grafting: a split mouth clinical study. *Quintessence International.* 2017;49(7):589-598.
  45. Romanos AH, Abou-Arraj RV, Cruz SE, Majzoub ZA. Clinical and patient-centered outcomes following treatment of multiple gingival recessions using acellular dermal matrix allografts. *Int J Periodont Rest Dent.* 2017;37(6):843-851.
  46. Abou Arraj RV, Kaur M, Vassilopoulos PJ, Geurs NC. Creation of a zone of immobile connective tissue with acellular dermal matrix allografts. *Int J Periodont Rest Dent.* 2017;37(4):570-579.
  47. Cardaropoli D, Tamagnone L, Roffredo A, Gaveglio L. Treatment of gingival recession defects using coronally advanced flap with a porcine collagen matrix compared to coronally advanced flap with connective tissue graft: a randomized controlled trial. *J Periodontol.* 2012;83(3):321-328.
  48. Nevins M, Nevins M, Soo-Woo Kim, et al. The use of mucograft collagen matrix to augment the zone of keratinized tissue around teeth: a pilot study. *Int J Periodont Rest Dent.* 2011;31:367-373.
  49. McGuire MK, Scheyer ET. A randomized, controlled clinical trial to evaluate a xenogeneic collagen matrix as an alternative to free gingival grafting for oral soft tissue augmentation. *J Periodontol.* 2014;85(10):1333-1341.
  50. Sanz M, Lorenzo R, Aranda JJ, et al. Clinical evaluation of a new collagen matrix (mucograft prototype) to enhance the width of keratinized tissue in patients with fixed prosthetic restorations: a randomized prospective clinical trial. *J Clin Periodontol.* 2009;36:868-876.
  51. Suárez-López Del Amo F, Rodríguez JC, Asa'ad F, Wang H-L. Comparison of two soft tissue substitutes for the treatment of gingival recession defects: an animal histological study. *J Appl Oral Sci.* 2019;27:e20180584. doi:10.1590/1678-7757-2018-0584
  52. McGuire MK, Scheyer ED, Nunn ME, Lavin PT. A pilot study to evaluate a tissue-engineered bilayered cell therapy as an alternative to tissue from the palate. *J Periodontol.* 2008;79:1847-1856.
  53. Nevins ML. Tissue-engineered bilayered cell therapy for the treatment of oral mucosal defects: a case series. *Int J Periodont Rest Dent.* 2010;30:31-39.
  54. Jepsen S, Caton JG, Albandar JM, et al. Periodontal manifestations of systemic diseases and developmental and acquired conditions: consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J Periodontol.* 2018;89(Suppl1):S237-S248.
  55. Ji JJ, Li XD, Fan Q, et al. Prevalence of gingival recession after orthodontic treatment of infraversion and open bite. *J Orofac Orthop.* 2019;80:1-8.
  56. Chambrone L, Tatakis DN. Long-term outcomes of untreated buccal gingival recessions: a systematic review and meta-analysis. *J Periodontol.* 2016;87:796-808.
  57. Tavelli L, Barotchi S, Avila-Ortiz G, et al. Peri-implant soft tissue phenotype modification and its impact on peri-implant health: a systematic review and network meta-analysis. *J Periodontol.* July 25, 2020. doi: 10.1002/JPER.19-0716. Epub ahead of print. PMID: 32710810.
  58. Alves LB, Costa PP, Scombatti de Souza SL, et al. Acellular dermal matrix graft with or without enamel matrix derivative for root coverage in smokers: a randomized clinical study. *J Clin Periodontol.* 2012;39:393-399.
  59. McGuire MK, Scheyer ET, Snyder MB. Evaluation of recession defects treated with coronally advanced flaps and either recombinant human platelet-derived growth factor-BB plus b-tricalcium phosphate or connective tissue: comparison of clinical parameters at 5 years. *J Periodontol.* 2014;85:1361-1370.
  60. McGuire MK, Scheyer ET, Schubach P. Growth factor-mediated treatment of recession defects: a randomized controlled trial and histologic and microcomputed tomography examination. *J Periodontol.* 2009;80:550-564.
  61. Shepherd N, Greenwell H, Hill M, et al. Root coverage using acellular dermal matrix and comparing a coronally positioned tunnel with and without platelet-rich plasma: a pilot study in humans. *J Periodontol.* 2009;80:397-404.
  62. Rasperini G, Rocuzzo M, Francetti L, et al. Subepithelial connective tissue graft for treatment of gingival recessions with and without enamel matrix derivative: a multicenter, randomized controlled clinical trial. *Int J Periodont Rest Dent.* 2011;31:133-139.
  63. Choukroun J, Diss A, Simonpieri A, et al. Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part V: Histologic evaluations of PRF effects on bone allograft maturation in sinus lift. *J Oral Maxillofac Surg* 2006; 101(3): 299-303.
  64. Ehrenfest DMD, de Peppo GM, Doglioli P, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): a gold standard to achieve for all surgical platelet concentrates technologies. *Growth Factors.* 2009;27(1):63-69.
  65. Nikolidakis D, Jansen JA. The biology of platelet-rich plasma and its application in oral surgery: literature review. *Tissue Eng Part B Rev.* 2008;14(3):249-258.
  66. Feigin K, Shope B. Use of platelet-rich plasma and platelet-rich fibrin in dentistry and oral surgery: introduction and review of the literature. *J Vet Dent.* 2019;36(2):109-123.
  67. Andia I, Rubio-Azpeitia E, Martin JI, Abate M. Current concepts and translational uses of platelet rich plasma biotechnology. In: *Biotechnology.* Ekinici D, ed. InTech. April 15, 2015.
  68. Cheung WS, Griffin TJ. A comparative study of root coverage with connective tissue and platelet concentrate grafts: 8-month results. *J Periodontol.* 2004;75(12):1678-1687.
  69. Huang L-H, Neiva REF, Soehren SE, et al. The effect of platelet-rich plasma on the coronally advanced flap root coverage procedure: a pilot human trial. *J Periodontol.* 2005;76(10):1768-1777.
  70. Kumari Chellathurai BN, Ganesh B, Rajaram V. Advanced platelet-rich fibrin in periosteal inversion techniques for root coverage—a case report. *Clin Adv Periodont.* 2020 [Epub ahead of print August 4, 2020]. <https://doi.org/10.1002/cap.10119>
  71. Tuttle D, Kurtzman GM, Bernotti AI. Gum drop technique: minimally invasive soft-tissue platelet-rich fibrin grafting for marginal soft tissue recession. *Compend.* 2018;39(5):1-7.
  72. Jankovic S, Aleksic Z, Klokkevold P, et al. Use of platelet-rich fibrin membrane following treatment of gingival recession: a randomized clinical trial. *Int J Periodontics Restor Dent.* 2012;32(2):e41-50.
  73. Jankovic S, Aleksic Z, Milinkovic I, Dimitrijevic B. The coronally advanced flap in combination with platelet-rich fibrin (PRF) and enamel matrix derivative in the treatment of gingival recession: a comparative study. *Eur J Esthet Dent.* 2010;5(3):260-273.
  74. Kulkarni M, Thomas B, Varghese J, Bhat G. Platelet-rich fibrin as an adjunct to palatal wound healing after harvesting a free gingival graft: a case series. *J Indian Soc Periodontol.* 2014;18(3):399-402.
  75. Ozsagir ZB, Saglam E, Yilmaz BS, et al. Injectable platelet-rich fibrin and microneedling for gingival augmentation in thin periodontal phenotype: a randomized controlled trial. *J Clin Periodontol.* 2020;47(4):489-499.
  76. Agrawal AA. Evolution, current status and advances in application of platelet concentrate in periodontics and implantology. *World J Clin Cases.* 2017;5(5):159-171.
  77. Fujioka-Kobayashi M, Schaller B, Mourão CF, et al. Biological characterization of an injectable platelet-rich fibrin mixture consisting of autologous albumin gel and liquid platelet-rich fibrin (Alb-PRF). *Platelets.* 2020:1-8.
  78. Miron RJ, Chai J, Zhang P, et al. A novel method for harvesting concentrated platelet rich fibrin (C-PRF) with a 10-fold increase in platelet and leukocyte yield. *Clin Oral Invest.* 2020;24(8):2819-2828.
  79. Izol BS, Uner DD. A new approach for root surface biomodification using injectable platelet-rich fibrin (i-PRF). *Med Sci Monit.* 2019;25:4744-4750.



**MARIA L. GEISINGER, DDS, MS,** is a professor and director of advanced education in periodontology in the Department of Periodontology in the University of Alabama at Birmingham (UAB) School of Dentistry. Dr. Geisinger received her BS in biology from

Duke University, her DDS from Columbia University School of Dental Medicine, and her MS and certificate in periodontology and implantology from the University of Texas Health Science Center at San Antonio. Dr. Geisinger is a diplomate in the American Board of Periodontology. She has served as the president of the American Academy of Periodontology Foundation and on multiple national and regional organized dentistry committees. She currently serves as chair of the American Dental Association's Council on Scientific Affairs and as a member of the American Academy of Periodontology's Board of Trustees. She has authored more than 45 peer-reviewed publications, and her

research interests include periodontal and systemic disease interaction, implant dentistry in the periodontally compromised dentition, and novel treatment strategies for oral soft- and hard-tissue growth. She lectures nationally and internationally on topics in periodontology and oral health care.



**JENNIFER HIRSCH DOOBROW, DMD, FADC, FICD,** is a board-certified periodontist and owner and CEO of Periodontal and Implant Associates, Inc., located in Cullman, Alabama. She earned her DMD at the Medical University of South Carolina and received her certification in periodontics from the University of Alabama (UAB) at Birmingham. She serves as a faculty member for the Pikos Institute, chair of the Alabama Dental Association Council on Budget and Auditing, and is a UAB Alumni Executive Council district

representative. Dr. Doobrow is the secretary-treasurer for the Southern Academy of Periodontology and sits on several committees for the American Academy of Periodontology. She holds past-president positions in the Alabama Society of Periodontists and the Wilson Chenault Dental Study Club, and she is a director for a Seattle Study Club located in Cullman, Alabama. In 2012, Dr. Doobrow was recognized as one of the University of Georgia's prestigious 40 Under 40. Most recently, she was selected as one of the Top 10 Young Educators in America for 2017 by the Seattle Study Club and was inducted as a fellow of the International College of Dentists, as well as a fellow of the American College of Dentists. She was also awarded the MUSC School of Dentistry Young Alumnus Award, the UAB School of Dentistry Outstanding Young Alumnus Award, and was featured on Lifetime Network's *The Balancing Act*, as well as on the Dentistry Uncensored podcast. She has authored numerous publications and lectures extensively throughout the United States on dental implants and periodontal regenerative therapies.

## ONLINE COMPLETION

Use this page to review questions and answers. Visit [dentalacademyofce.com](http://dentalacademyofce.com) and sign in. If you have not previously purchased the course, select it from the Online Courses listing and complete your online purchase. Once purchased, the exam will be added to your Archives page, where a Take Exam link will be provided. Click on the Take Exam link, complete all the program questions, and submit your answers. An immediate grade report will be provided. Upon receiving a grade of 70% or higher, your verification form will be provided immediately for viewing and printing. Verification forms can be viewed and printed at any time in the future by visiting the site and returning to your Archives page.

**QUICK ACCESS code 21010**

## QUESTIONS

- Gingival recession and subsequent root surface exposure is associated with all of the following except:**
  - Esthetic compromise
  - Increased rate of radicular caries
  - Increased rate of edentulism
  - Dentinal hypersensitivity
- Established soft tissue grafting techniques used in periodontal defects include:**
  - Free gingival graft (FGG)
  - Coronally advanced flap with subepithelial connective tissue graft (CAF + sCTG)
  - Coronally advanced flap with acellular dermal matrix (CAF + ADM)
  - All of the above
- Current platelet concentrates (PCs) used in dentistry for augmentation of soft tissue grafting techniques include(s):**
  - Platelet-rich plasma (PRP)
  - Leukocyte-rich platelet-rich fibrin (L-PRF)
  - Injectable platelet-rich fibrin (i-PRF)
  - All of the above
- All of the following are true about platelet concentrates (PCs), except:**
  - PCs are autogenous materials derived from whole blood.
  - PCs contain increased concentrations of growth factors and cytokines involved in wound healing and repair.
  - All PCs require the use of exogenous thrombin.
  - All PC preparation requires centrifugation.
- Which of the following are growth factors that are released by PCs?**
  - Platelet-derived growth factor (PDGF)
  - Transforming growth factor- $\beta$  (TGF- $\beta$ )
  - Vascular endothelial growth factor (VEGF)
  - All of the above
- The American Academy of Periodontology's glossary of terms defines a mucogingival deformity as "a departure from the normal dimension and morphology of, and/or interrelationship between gingiva and alveolar mucosa; the abnormality may be associated with a deformity of the underlying \_\_\_\_."**
  - Tooth structure
  - Alveolar bone
  - Connective tissue
  - Periosteum
- Mucogingival deformities include all of the following except:**
  - Periodontitis
  - Gingival recession
  - Lack of keratinized and/or attached gingiva
  - Aberrant frenum/muscle position
- The success of treatments for gingival recession is influenced by:**
  - Individual recession depths
  - Gingival thickness
  - Interdental clinical attachment level (CAL)
  - All of the above

Use this page to review questions and answers. Visit [dentalacademyofce.com](http://dentalacademyofce.com) and sign in. If you have not previously purchased the course, select it from the Online Courses listing and complete your online purchase. Once purchased, the exam will be added to your Archives page, where a Take Exam link will be provided. Click on the Take Exam link, complete all the program questions, and submit your answers. An immediate grade report will be provided. Upon receiving a grade of 70% or higher, your verification form will be provided immediately for viewing and printing. Verification forms can be viewed and printed at any time in the future by visiting the site and returning to your Archives page.

## QUESTIONS

9. Gingival thickness of less than \_\_\_\_ is associated with reduced root coverage in procedures that utilize coronally advanced flaps without additional soft tissue graft materials.
- 0.5 mm
  - 1.0 mm
  - 2.0 mm
  - 5.0 mm
10. All of the following are true about gingival recession defects classified as Cairo recession type 1 (RT1) except:
- Interproximal CEJ is not clinically detectable on the buccal aspect of the tooth.
  - No loss of interdental bone is noted.
  - Complete root coverage can be anticipated.
  - Interproximal CEJ is not clinically detectable at both mesial and distal aspects of the tooth.
11. All of the following cells generally characterize normal soft tissue healing after grafting procedures except:
- Fibroblasts
  - Odontoblasts
  - Epithelial cells
  - Endothelial cells
12. Healing at sites where soft tissue procedures were used generally involve:
- Formation of immature fibrovascular tissue (i.e., granulation tissue) containing fibroblasts, collagen, and blood vessels that precedes mature angiogenesis
  - Keratinization based upon the phenotype of the original source of materials
  - Resorption of graft materials over time
  - A and B
13. Autogenous grafts generally survive initially through \_\_\_\_ prior to angiogenesis and anastomosis of existing capillaries to allow for reestablishment of blood supply to the graft.
- Salivary nutrients
  - Plasmatic circulation
  - Gingival crevicular fluid nutrients
  - None of the above
14. PCs, specifically PRF, have demonstrated an upregulation of proliferation of various cell types, including:
- Periodontal ligament fibroblasts (PDL-F)
  - Gingival fibroblasts (GF)
  - Osteoblasts
  - All of the above
15. Autogenous free gingival grafts (FGG) have been used to treat gingival recession defects since 1957. All of the following are true about FGGs except:
- Sites treated with FGGs demonstrate marked increases in the width of keratinized and attached gingiva postoperatively.
  - FGGs are considered the gold standard for root coverage procedures.
  - FGGs demonstrate less predictable root coverage when compared to CAF + sCTG.
  - FGGs often heal with color discrepancies with the surrounding gingival tissues.
16. Allogeneic grafts have demonstrated an ability to achieve predictable root coverage, particularly at sites without interproximal bone loss (e.g., Cairo RT1). These techniques demonstrate significantly less increase in keratinized gingiva than CAF + sCTG.
- Both statements are true.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.
  - Both statements are false.
17. Living cellular constructs used in soft tissue grafting are:
- Created using cells harvested from the patient being treated
  - Bioengineered scaffolds embedded with autogenous cells
  - Cell-embedded constructs composed of living allogeneic human fibroblasts and keratinocytes, bovine collagen, and human extracellular proteins
  - Able to deliver better postoperative results for root coverage than CAF + sCTG
18. The term periodontal phenotype refers to the bone and gingival characteristics, including keratinized tissue and bone and gingival thickness. The presence of a thin periodontal phenotype has been associated with a greater risk for developing gingival recession over a patient's lifetime and also as a consequence of specific dental therapies, including restorative and orthodontic therapies.
- Both statements are true.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.
  - Both statements are false.
19. Sites with keratinized tissue width of less than 2 mm have been associated with:
- Increased probability of marginal bone loss
  - Increased likelihood of patient discomfort at those sites
  - Increased rates of bleeding on probing (BOP) at those sites
  - All of the above

Use this page to review questions and answers. Visit [dentalacademyofce.com](http://dentalacademyofce.com) and sign in. If you have not previously purchased the course, select it from the Online Courses listing and complete your online purchase. Once purchased, the exam will be added to your Archives page, where a Take Exam link will be provided. Click on the Take Exam link, complete all the program questions, and submit your answers. An immediate grade report will be provided. Upon receiving a grade of 70% or higher, your verification form will be provided immediately for viewing and printing. Verification forms can be viewed and printed at any time in the future by visiting the site and returning to your Archives page.

## QUESTIONS

20. The use of biologic mediators, including PCs, has been suggested to improve outcomes at sites with more complex clinical presentations and in patients with other complicating factors, including:
- Cairo RT2 and RT3 gingival recession defects
  - Defects in smokers
  - Defects in patients with poorly controlled diabetes mellitus
  - All of the above
21. Advantages of PCs for adjunctive use in soft tissue grafting procedures include all of the following except:
- Their autologous nature
  - They are readily harvested on the day of surgery
  - They require complex and time-consuming preparation prior to surgery
  - They may contain a combination of growth factors in physiologic ratios
22. PCs are known to contain growth factors from platelets' alpha granules, including:
- Platelet-derived growth factor (PDGF)
  - Vascular endothelial factor (VEGF)
  - Transforming growth factor-beta (TGF-  $\beta$ )
  - All of the above
23. Application of PCs during soft tissue grafting results in greater postoperative root coverage with coronally advanced flap (CAF). Application of PCs during soft tissue grafting results in greater postoperative root coverage with coronally advanced flap (CAF) and subepithelial connective tissue graft (CAF + sCTG).
- Both statements are true.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.
  - Both statements are false.
24. Sites treated with root coverage procedures and adjunctive PC use have been shown to demonstrate \_\_\_\_ gingival index and \_\_\_\_ gingival thickness as compared to such procedures without PCs.
- Superior, greater
  - Equivalent, greater
  - Superior, less
  - Equivalent, less
25. PCs may improve postoperative pain control and patient-reported outcomes during the healing phase. These improvements have been attributed to the more rapid healing progression attributed to PC application.
- Both statements are true.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.
  - Both statements are false.
26. The use of PRF as a biologic bandage at palatal donor sites after harvest of CTG or FGG grafts may provide:
- Faster healing at autologous graft donor sites
  - Decreased postoperative morbidity
  - Higher levels of patient acceptance for grafting procedures
  - All of the above
27. The use of microneedling and injectable PCs has been adapted from dermatologic and plastic surgery applications as methods to:
- Increase root coverage
  - Increase hard-tissue thickness
  - Increase gingival thickness and alter periodontal phenotype
  - Alter gingival color variations
28. Advanced platelet-rich fibrin (A-PRF) has been associated with:
- Increased macrophage differentiation
  - Improved root coverage after use in soft tissue grafting
  - Improved histologic fibrin organization
  - Increased number of fibroblasts within the PRF material
29. Titanium prepared platelet-rich fibrin (T-PRF) is prepared using titanium vials rather than glass and this has been associated with:
- Improved root coverage after use in soft tissue grafting
  - Increased structural integrity of the PRF material after preparation
  - Increased cellularity of the PRF material
  - Decreased quantities of growth factors within the PRF materials
30. The adjunctive use of PCs during soft tissue grafting procedures may provide distinct benefits during periodontal plastic surgery procedures aimed at increasing root coverage and altering the periodontal phenotype. The use of such materials in cases where patient and/or site-specific factors are likely to result in less predictable outcomes may provide increased likelihood of beneficial clinical results.
- Both statements are true.
  - The first statement is true; the second statement is false.
  - The first statement is false; the second statement is true.
  - Both statements are false.

## Stick to your gums! Platelet concentrates and soft-tissue grafting

NAME:	TITLE:	SPECIALTY:
ADDRESS:	EMAIL:	AGD MEMBER ID (IF APPLIES):
CITY:	STATE:	ZIP: COUNTRY:
TELEPHONE (PRIMARY):	TELEPHONE (OFFICE):	

**REQUIREMENTS FOR OBTAINING CE CREDITS BY MAIL/FAX:** 1) Read entire course. 2) Complete info above. 3) Complete test by marking one answer per question. 4) Complete course evaluation. 5) Complete credit card info or write check payable to Endeavor Business Media. 6) Mail/fax this page to DACE. If you have any questions, please contact [dace@endeavor2b.com](mailto:dace@endeavor2b.com) or call (800) 633-1681. A score of 70% or higher is required for CE credit.

**COURSE CAN ALSO BE COMPLETED ONLINE AT A LOWER COST.** Scan the QR code or go to [dentalacademyofce.com](http://dentalacademyofce.com) to take advantage of the lower rate.



### Educational Objectives

- Understand the prevalence, etiology, and treatment options for gingival recession.
- Discuss the applications of platelet concentrates for enhancing the outcomes of soft-tissue grafting procedures.
- Select the appropriate preparation protocol to achieve good and predictable results utilizing soft-tissue grafting and platelet concentrates.
- Evaluate the gaps in our current scientific knowledge regarding platelet concentrates and soft-tissue grafting procedures.

### Course Evaluation

1. Were the individual course objectives met?

Objective #1: Yes No      Objective #3: Yes No  
 Objective #2: Yes No      Objective #4: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

- |                                                                          |     |    |   |   |   |   |
|--------------------------------------------------------------------------|-----|----|---|---|---|---|
| 2. To what extent were the course objectives accomplished overall?       | 5   | 4  | 3 | 2 | 1 | 0 |
| 3. Please rate your personal mastery of the course objectives.           | 5   | 4  | 3 | 2 | 1 | 0 |
| 4. How would you rate the objectives and educational methods?            | 5   | 4  | 3 | 2 | 1 | 0 |
| 5. How do you rate the author's grasp of the topic?                      | 5   | 4  | 3 | 2 | 1 | 0 |
| 6. Please rate the author's effectiveness.                               | 5   | 4  | 3 | 2 | 1 | 0 |
| 7. Was the overall administration of the course effective?               | 5   | 4  | 3 | 2 | 1 | 0 |
| 8. Please rate the usefulness and clinical applicability of this course. | 5   | 4  | 3 | 2 | 1 | 0 |
| 9. Please rate the usefulness of the references.                         | 5   | 4  | 3 | 2 | 1 | 0 |
| 10. Do you feel that the references were adequate?                       | Yes | No |   |   |   |   |
| 11. Would you take a similar course on a different topic?                | Yes | No |   |   |   |   |

12. If any of the continuing education questions were unclear or ambiguous, please list them.

13. Was there any subject matter you found confusing? Please describe.

14. How long did it take you to complete this course?

15. What additional dental continuing education topics would you like to see?

Mail/fax completed answer sheet to:

### Endeavor Business Media

Attn: Dental Division  
 7666 E. 61st St. Suite 230, Tulsa, OK 74133  
 Fax: (918) 831-9804

Payment of \$69 is enclosed (this course can be completed online for \$59. Scan the QR code or go to [dentalacademyofce.com](http://dentalacademyofce.com) to take advantage of the lower rate).

#### Make check payable to Endeavor Business Media

If paying by credit card, please complete the following:

MC     Visa     AmEx     Discover

Acct. number: \_\_\_\_\_

Exp. date: \_\_\_\_\_ CVC #: \_\_\_\_\_

Billing address: \_\_\_\_\_

Charges on your statement will show up as Endeavor.

- |                                                                                                     |                                                                                                     |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 1. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 16. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 2. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 17. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 3. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 18. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 4. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 19. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 5. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 20. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 6. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 21. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 7. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 22. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 8. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 23. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 9. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D  | 24. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 10. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 25. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 11. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 26. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 12. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 27. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 13. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 28. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 14. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 29. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |
| 15. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D | 30. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D |

#### EXAM INSTRUCTIONS

All questions have only one answer. If mailed or faxed, grading of this examination is done manually. Participants will receive confirmation of passing by receipt of a Verification of Participation form. The form will be mailed within two weeks after receipt of an examination.

#### COURSE EVALUATION AND FEEDBACK

We encourage participant feedback. Complete the evaluation above and e-mail additional feedback to [Aileen.Southerland@endeavor2b.com](mailto:Aileen.Southerland@endeavor2b.com) and [Laura.Winfield@endeavor2b.com](mailto:Laura.Winfield@endeavor2b.com).

#### COURSE CREDITS AND COST

All participants scoring 70% or higher on the examination will receive a verification form for three (3) continuing education (CE) credits. Participants are urged to contact their state dental boards for CE requirements. The cost for courses ranges from \$20 to \$110.

#### PROVIDER INFORMATION

Endeavor Business Media is an ADA CERP-recognized provider. ADA CERP is a service of the American Dental Association to assist dental professionals in identifying quality providers of continuing dental education. ADA CERP neither approves nor endorses individual courses or instructors, nor does it imply acceptance of credit hours by boards of dentistry. Concerns about a CE provider may be directed to the provider or to ADA CERP at [ada.org/cerp](http://ada.org/cerp).

Endeavor Business Media is designated as an approved PACE program provider by the Academy of General Dentistry. The formal continuing dental education programs of this program provider are accepted by the AGD for fellowship, mastery, and membership maintenance credit. Approval does not imply acceptance by a state or provincial board of dentistry or AGD endorsement. The current term of approval extends from 11/1/2019 to 10/31/2022. Provider ID# 320452. AGD code: 490.

Dental Board of California: Provider RP5933. Course registration number CA code: 03-5933-21010. Expires 7/31/2022. \*This course meets the Dental Board of California's requirements for three (3) units of continuing education.\*

Endeavor Business Media is designated as an approved provider by the American Academy of Dental Hygiene Inc. #AADHPNW (January 1 2021 - December 31, 2022). Approval does not imply acceptance by a state or provincial board of dentistry. Licensee should maintain this document in the event of an audit.

#### RECORD KEEPING

Endeavor Business Media maintains records of your successful completion of any exam for a minimum of six years. Please contact our offices for a copy of your CE credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

#### CANCELLATION AND REFUND POLICY

Participants who are not 100% satisfied can request a refund by contacting Endeavor Business Media in writing.

#### IMAGE AUTHENTICITY

The images in this educational activity have not been altered.

© 2021 Academy of Dental Therapeutics and Stomatology, a division of Endeavor Business Media