Technical Note

Platelet-rich Fibrin Minimally Invasive Root Recession Soft-Tissue Grafting

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Abstract

A common problem encountered in every dental practice, root recession presents as an esthetic issue as well as creating exposed root surfaces that may illicit sensitivity and have greater caries potential than covered roots. Frequently, patients avoid treatment due to fear related to the traditional flap surgery approach. Technology, via biologics from the patient being treated has shifted surgical techniques to become minimally invasive, allowing lower morbidity and post-operative discomfort. The Gum Drop Technique (GDT) a papilla preservation technique, with a less invasive surgical approach utilizing PRF as the graft material with improved healing compared to packaged materials will be discussed as an alternative to traditional flap surgical approaches for root recession treatment.

Keywords: Minimally invasive, Platelet-rich Fibrin, recession, root coverage

Introduction

A commonly encountered problem is root recession. Recession presents both as an esthetic issue and exposed root surfaces may illicit sensitivity with a greater caries potential than unexposed roots. Patients often avoid recession treatment due to fear related to the traditional approach requiring flap surgery. Treatment has evolved to minimally invasive surgical techniques, allowing lower morbidity and postoperative discomfort. This article will introduce "The Gum Drop Technique" (GDT), a new soft-tissue grafting technique combining minimally invasive incisions with patient blood derivatives to achieve stable root coverage.

Root coverage procedures have been described in the literature with varying degrees of success. Miller in the early 1980s[1,2] discussed the use of free gingival autografting. Numerous authors expounded on this including Matter,[3] Marggraf,[4] McGuire,[5] Laney *et al*.,[6] and others, discussing various flap techniques to achieve desired root coverage. As less invasive techniques were sought, modifications were utilized and the "tunnel" technique was reported by Mahn in 2001,[7] utilizing smaller incisions with placement of acellular connective tissue to bulk the tissue out, allowing coronal placement to cover the receded root surfaces. These techniques allowed avoidance of collecting donor connective tissue intraorally.

Blood-Derived Biologics

Biological factors derived from the patients' blood have been introduced as solo or combination agents to increase wound healing and success rates. Those blood-derived products, platelet-rich plasma (PRP), promote tissue regeneration and alveolar bone repair have been well documented for repair of extraction sockets to ridge augmentation for defect correction and implant site development.[8,9] As the biologics were further studied, a second generation of patient blood-derived factors were introduced, Platelet rich fibrin (PRF). These are also referred to as leukocyte and PRF as autologous platelets and leukocytes are present in a complex fibrin matrix which accelerates soft- and hard-tissue healing. The simplified PRF preparation does not require biochemical blood handling that was necessary with PRP. Initial analyses revealed that PRF may have an inflammation retrocontrol ability, which would explain

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the reduction of postoperative infections when PRF is used as surgical additive.[10-13] Choukroun reported 4 months of healing time when PRF was included in the graft compared with a control group (at 8 months); the histologic maturation between the two groups was identical. Moreover, the quantity of newly formed bone was equivalent between the 2 protocols.[14] These observations have been supported by other studies indicating an acceleration in healing with PRF without any detrimental effect on the quality of the resulting bone and an improvement in overall osseous regeneration and soft-tissue healing resulted.[15] Further PRF induced a significantly higher proliferation rate at 3 and 5 days compared to PRP.[16] This may be related to the increase of growth factors in PRF on new blood vessel proliferation (angiogenesis) that is crucial to maturation of the hard-tissue graft and soft-tissue healing.[17] In addition, the concentrated fibrin component acts like a tissue glue holding the hard-tissue graft material together into a moldable material and making it adhesive to the underlying bone and overlaying soft tissue. When utilized in soft-tissue procedures, it binds the tissue into position allowing better healing and better immobilization of the flap with reported accelerated wound and site healing.[18]

The fibrin clot that is derived from the centrifuged blood at 1300 rpm/8 min becomes a membrane that can be used in place of autogenous connective tissue or acellular membranes in various procedures. This is referred to as advanced-PRF (A-PRF). The injectable version of PRF centrifuged at 700 rpm/3 min (i-PRF) has demonstrated the ability to release higher concentrations of various growth factors and induced higher fibroblast migration and growth factor expression (platelet-derived growth factor [PDGF], transforming growth factor-beta, and collagen Type 1) improving soft-tissue healing as would be important in treatment of gingival recession.[19] The low speed and low centrifugation concept (settings from 2700 rpm/12 min to 1300/8 min) changed the entire dynamics of the clot increasing not only the number of cells, vessels but the matrix as well by increasing the growth factors, cytokines, and fibronectin. The GDT, developed by Dr. Tuttle, utilizes the biologic benefits of PRF in the treatment of root recession to provide a stable long-term result with reattachment to the root surfaces.

Gum Drop Technique

The GDT encompasses the positive benefits of an autogenous, minimally invasive, and biologically enhanced soft-tissue procedure.

At the surgical appointment, before surgery, peripheral blood is collected from the patient in 10 ml vials. The tubes do not contain anticoagulant and are immediately centrifuged to 1300 rpm for 8 min, utilizing a centrifuge designed for PRF processing (DuoQuattro Centrifuge, Process for PRF, Nice, France). After completion of centrifuging, the fibrin clot is separated from the red blood cell (RBC) component using tweezers to remove the clot from the tube and scissors are utilized to separate the RBC portion from the fibrin. The fibrin clot is placed onto a metal tray and a weighted cover is placed over the clots to express any residual fluid creating an A-PRF membrane for only 3 min.

One-two mm of keratinized tissue is required to be present to perform GDT. Scaling and root planning is performed to remove any calculus. Root lesions that may be present (abfraction, erosion except for decay) are treated by modification of the lesion with fine diamond finishing burs (859EF, Komet USA, Charlotte, NC) in a high-speed handpiece are next utilized to smooth the cervical area of the teeth being treated and remove any sharp edges [Figure 1]. The roots are then chemically decontaminated with minocycline (Watson Pharmaceuticals/ Actavis Inc., Corona, CA, USA) created by emptying a capsule of the antibiotic into a dappen dish and adding normal saline (0.9%) to create a paste [Figure 2]. The paste is then applied to the root surfaces for a duration of 2–3 min and then rinsed off.

The surgical procedure is initiated by placement of holes in the gingiva apical to the mucogingival line using a small gum piercing instrument [Figure 3]. These holes are comparable to those used in laparoscopic procedures in medical surgeries. Four holes are usually sufficient to treat the entire arch. Appropriate instruments (straight and angled soft-tissue elevators) are used to create a full thickness tunnel between the entrance holes and extended to the cementoenamel junction (CEJ) of each tooth sparing the tip of the papilla (not detached from the underlying bone) to allow repositioning of the soft tissue to cover the root recession. The resulting tissue creates a tension-free flap allowing movement of the gingival margin in a more coronal direction to cover the root recession being treated. The tunnel created in the elevated tissue is irrigated with plasma exudate to place growth factors in the irrigant into the site and aid in regeneration [Figure 4]. The A-PRF membranes previously created are introduced through the entrance holes under the elevated soft tissue [Figure 5]. Multiple A-PRF membranes are placed until sufficient bulking of the gingival tissue has been achieved. Typically, 25–30 membranes are required per arch. The gingiva is advanced toward the CEJ as the membranes are placed over the roots and under the papillae. The level of coronal placement of the flap plays an important role in increasing the chance of achieving 100% root coverage. To predictably achieve this, it has been suggested that tissue needs to be advanced 2 mm or more coronal to the tooth's CEJ.[20]

The composite bonded at the interproximals acts as stabilization points for the sutures [Figure 6]. The coronally advanced flap is maintained in position using an apical mattress suture.[21] The author recommends a long-term resorbable 5-0 polyglycolic acid suture as the sutures need to remain for 3–4 weeks while the tissue reattaches to the underlying bed and in close proximity to the roots [Figure 7].

At the completion of surgery, another blood drawing is taken to obtain the i-PRF (700 rpm/3 min) and A-PRF

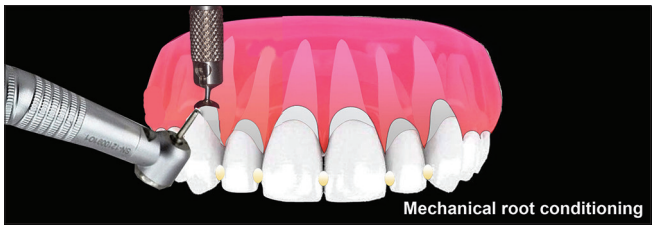

Figure 1: The Gum Drop Technique following scaling and root planning is initiated by mechanical conditioning of the exposed root surfaces and any alterations to the cementoenamel junction such as abfraction lesions with finishing diamonds (859EF, Komet USA, Charlotte, NC)

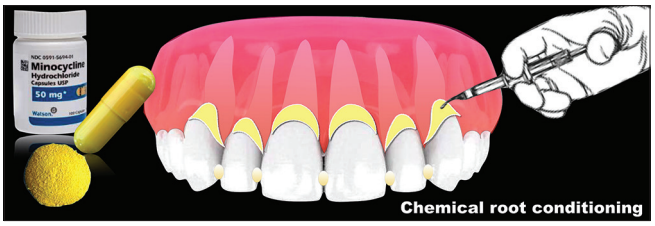

Figure 2: The exposed root surfaces are chemically conditioned with minocycline made into a paste by mixing a capsule with a few drops of normal saline solution

Figure 3: The gum is pierced with an instrument 3 mm apical to the mucogingival line in three spots on the arch

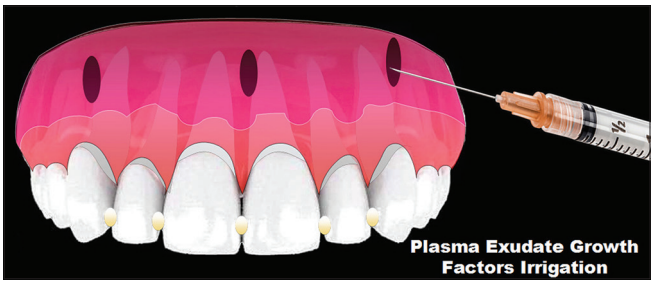

Figure 4: Patient-derived plasma growth factors are introduced into the gum piercings following elevation of the tissue through the holes with a syringe

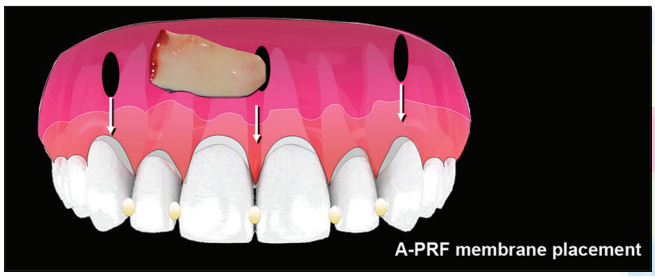

Figure 5: A-PRF membranes are introduced through the gum piercings to position the elevated gingival tissue in a coronal direction covering the gingival recession

Figure 6: Composite is bonded to the proximal contacts to allow for fixation points for sutures to be placed

liquid (1300/4 min). The i-PRF liquid obtained from above the red layer of RBCs is drawn off into a syringe from the tube and is injected into the surgical sites at the mesial and distal into the periodontal ligament (PDL) to stimulate regeneration as well into the facial aspect of the gingiva [Figure 8]. The fibrin glue properties of the PRF solidarize the membranes in the tunnel increasing the clot and flap mechanical immobilization. The growth factors and mesenchymal cells from the i-PRF further stimulate fibroblast growth and cell migration that will repopulate the root surface to assist the attachment of the flap to the root surface.[22]

Case Example 1

A 54-year-old male patient presented with the complaint of sensitivity in the maxillary right quadrant. Examination noted severe recession on the canine and both premolars with associated abfraction lesions are present [Figure 9]. Noted were the blunted papillae which may decrease root coverage success. A laser frenectomy was performed (Precise LTM, CAO Group, Jordan, UT) in conjunction with GDT to eliminate the lateral frenum. The patient had a Miller Class III and IV. Pulpal involvement was not noted and sensitivity was related to the exposed root surfaces and abfraction lesions. GDT was performed as described. The root recession has remained stable at the 9-month recall, demonstrating a lack of inflammation and healthy tissue with the patient reporting no sensitivity [Figure 10].

Case Example 2

A 60-year-old female presented with a chief complaint of moderate sensitivity in the maxillary left quadrant and slight sensitivity in the mandibular left quadrant. Combination lesions (abfraction and erosion) were noted on the maxillary canine and 1st premolar and mandibular 1st premolar and 1st molar [Figure 11]. A Miller Class III and IV were noted, and the maxillary left lateral incisor presented with attrition and a blunted distal papilla. Root surfaces at the lesions were hard to the explorer. The patient was elected to treat the maxillary

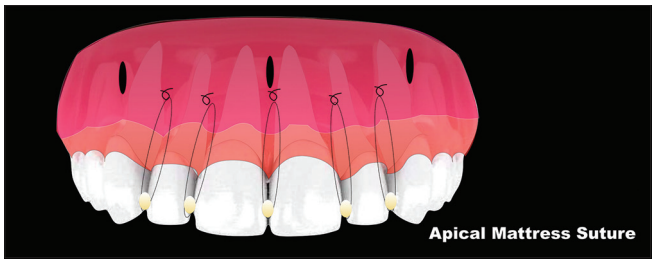

Figure 7: Apical mattress sutures are placed with anchorage at the previously placed composite at the contacts to fixate the newly repositioned gingival tissue

Figure 9: The patient presented with severe recession in the maxillary right canine-premolar region and mild recession on the lateral and central incisors with abfraction type lesions on the roots

root recession and GDT was performed. A year later, the patient chose to address the mandibular root recession, and GDT was performed on those teeth. Laser vestibuloplasty was performed (Precise LTM) 6 weeks before the lower quadrant root coverage procedure to provide adequate tissue to achieve root coverage and has the mobilized tissue be tension free. At recall (15 months maxillary and 5 months mandibular), the patient reports that all sensitivities have been absent following the surgeries, and the tissue demonstrates a lack of inflammation and stability of the root recession treatment [Figure 12].

Discussion

Gingival recession is a common occurrence and has been addressed by various surgical approaches. The GDT addresses the goals of root recession coverage with a biological approach to stimulate healing, reduce inflammation during healing, and provide long-term stability of the repositioned gingival margin. Normal regeneration has been shown to require cell death as the tissue must sense an injury, initiate a regenerative response, and then properly direct growth.[23-25] Those dying cells release signals that stimulate the regenerative response in progenitor cells in the injured area.[26] Progenitor cells once stimulated by the trauma at the localized injury interact with the cells in the PRF that has been placed into the surgical site. Stimulation of the periosteum with blunt instruments as the tunnel is elevated provides the needed trauma to initiate regeneration,

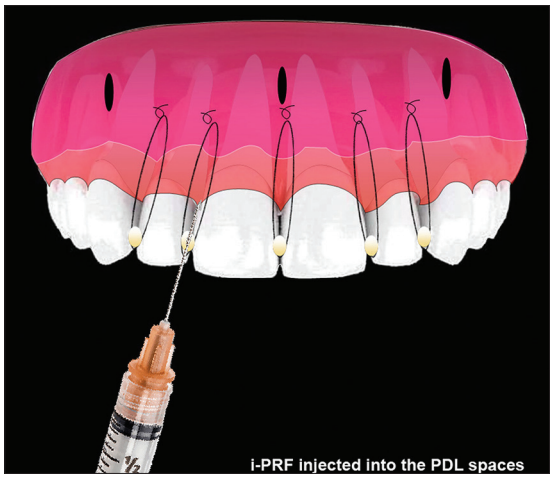

Figure 8: Injectable plasma-rich fibrin is injected into the periodontal ligament spaces to stimulate regeneration and into the tunnel to solidarize the membranes, increasing clot and flap mechanical immobilization

Figure 10: The patient at 9-month posttreatment with the Gum Drop Technique demonstrating stability of the root recession treatment performed with complete root coverage

and injection of the i-PRF into the site provides cells required to fuel regeneration of the tissue and PDL.

The growth factors released from platelets and leukocytes within the A-PRF and i-PRF stimulate new blood vessel growth through vascular endothelial growth factor (VEGF) and fibroblast growth factor. This stimulating factor encourages new attachment of the gingival tissue to the root surface creating a stable attachment. Agents which promote PDL fibroblast proliferation and migration as well as collagen biosynthesis appear to be mediators for enhancing new PDL formation.[27] PRF is rich in VEGF and PDGF. VEGF contributes to angiogenesis to the new tissue as success of any grafting procedure depends on the blood supply and vascularization of the tissues involved.[28] Angiogenesis and migration of endogenous stem cells were much more abundant in the presence of VEGF.[29] Whereas PDGF is a mitogen (stimulator) for cells of mesenchymal origin including fibroblasts providing a role in periodontal regeneration.[30,31]

Figure 11: The patient presented with moderate recession in the maxillary left canine-premolar and more severe recession in the mandibular left premolar-molar areas with combination abfraction erosion type lesions

Figure 12: The maxillary left at 15 months and mandibular left 5 months postGum Drop Treatment demonstrating stability of the root recession treatment

The CEJ is often difficult to identify in patients presenting with cervical lesions as these are missing enamel and cementum. In addition, Miller Class III and IV gingival recessions may require vestibuloplasty in some cases to allow sufficient tissue to coronally place that is tension free and may need to be performed before coverage of the root recession.

Conclusion

The morbidity of the GDT is less than traditional techniques that have been employed to treat multiple or single root recession in natural dentition and implants. The GDT, a papilla preservation technique, has a less invasive surgical approach which has shown higher patient case acceptance. This new biological approach involving blood derivatives A-PRF and i-PRF combined with a minimally invasive surgical approach for root recession elimination demonstrates faster healing without the need for a donor site to provide connective tissue. Improvement in tissue biotype is achieved and relates to the biocompatibility of the patients' own blood products used in the GDT procedure.

Emdogain has been in use to improve tissue reattachment and has been well reported in the literature. PRF has shown promise as an alternative to Emdogain with the additional benefits of its "tissue glue-" like properties at the site with both hard- and soft-tissue grafts, plus the decrease in material costs it affords. Further study is indicated in comparing these two materials.

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Conflicts of interest

There are no conflicts of interest.

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