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Selecting Root Coverage Techniques for Autogenous Soft Tissue Grafts at Isolated and Multiple-Adjacent Mandibular Anterior Recession Defects

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Abstract

It is widely acknowledged that multiple anatomic and technical factors hinder successful root coverage in the mandibular anterior region. Nevertheless, the contemporary periodontal plastic surgeon is presented with a panoply of options when deciding upon the most appropriate technique to apply in a particular clinical scenario. Although many techniques are applicable at a variety of defect types, several are particularly well suited for specific situations commonly encountered in the mandibular anterior. The purpose of this report is to describe rationale for preferred autogenous soft tissue grafting techniques at isolated mandibular incisor sites, isolated mandibular canine sites, and multiple-adjacent recession defects in the mandibular anterior. Four cases are presented to exemplify the recommended procedures.

Keywords: Clinical Protocols, Treatment Outcome, Gingiva, Plastic Surgery, Autografts

Abbreviations: MRD: Multiple Adjacent Recession Defects, CEJ: Cementoenamel Junction, RP: Raetzke Pouch, EDTA: Ethylenediaminetetraacetic Acid, EMD: Enamel Matrix Derivative, PGA/PCL: Polyglycolic Acid/Polycaprolactone, FGG: Free Gingival Graft, DPF: Double Pedicle Flap, CTG: Connective Tissue Graft

Introduction

Root coverage results are among the most studied treatment outcomes in periodontics **[1-5]**. Overall, the subepithelial connective tissue graft with coronally advanced flap has emerged as the "gold standard" therapy with respect to complete root coverage frequency, mean percent root coverage, and long-term stability **[1,2,4,5]**. However, gaps exist in the available evidence, and important clinical questions remain. Conclusions about the relative efficacy of root coverage procedures derive from data biased toward observations at maxillary canine and premolar sites **[1-5]**. Tooth position is known to affect root coverage outcomes at isolated and multiple adjacent gingival recession defects **[6,7]**

and at mandibular anterior sites, several additional anatomic challenges may influence the attainable therapeutic result **[8]**. Interdental spaces in this anatomic region are typically the narrowest in the mouth **[9]** and alveolar dehiscence defects are common **[10]**. Thus, papillae are narrow and delicate, and the surface area offering blood supply to the implanted graft may be minimal. Aberrant frenal attachments, unfavorable vestibular depth, muscle activity, and diminutive attached gingiva dimensions also have the potential to limit efficacy of root coverage procedures in this area **[11-13]**. Controlled clinical investigations specifically comparing root coverage techniques in the mandibular anterior are rare, and to date, available evidence has not permitted definitive conclusions. In this context, clinical judgement and operator preference remain relevant. The purpose of this report to present rationale for root coverage technique selection for multiple adjacent and isolated recession defects at mandibular anterior sites, focusing on methods involving autogenous soft tissue grafts **(Figure 1, Table 1)**.

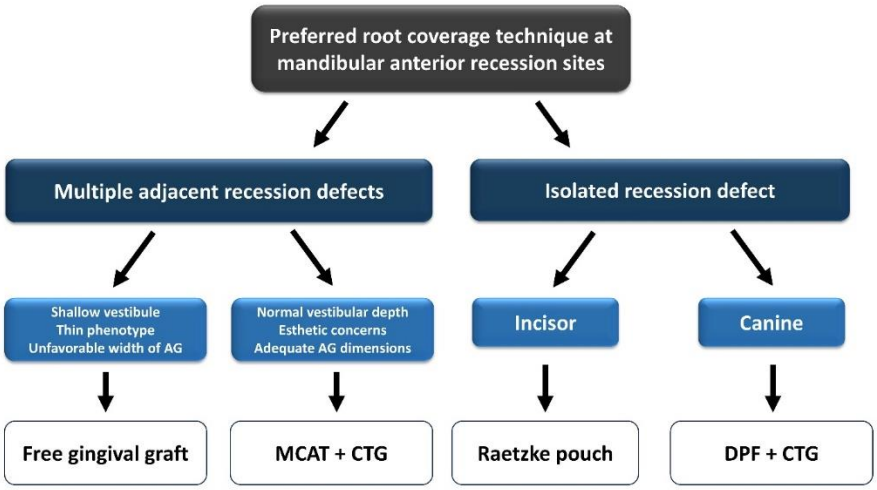

Figure 1. Decision tree: root coverage technique selection for multiple adjacent and isolated recession defects at mandibular anterior sites. In most root coverage cases, positive treatment outcomes are achievable using a variety of surgical materials and techniques. However, certain procedures offer simplicity while addressing anatomic challenges commonly encountered in the mandibular anterior. AG: attached gingiva, MCAT: modified coronally advanced tunnel, DPF: double pedicle flap, CTG: connective tissue graft.

Table 1. Rationale for technique preferences at mandibular anterior recession defect sites

Clinical scenario	Preferred technique	Rationale/advantages	Disadvantages
Isolated incisor recession defect	Raetzke pouch (envelope technique)	• Preserves periodontal attachment of adjacent teeth. • Expedient. Minimal treatment time. • Possibly limits postoperative morbidity.	• Inefficient and not well suited for cases involving multiple defects. • Does not involve coronally advancing the marginal tissue beyond the cementoenamel junction, which is desirable for attaining complete root coverage.
Multiple adjacent recession defects	Free gingival graft	• Addresses anatomic concerns that are commonly present: shallow vestibule, thin phenotype, unfavorable zone of attached gingiva, aberrant frenal attachments. • Gold standard for increasing the dimensions of the attached gingiva.	• Possibly greater donor site discomfort compared with alternative techniques. • Inconsistent gingival contours. • Poor color match with adjacent tissue.

		• Clinical outcome may continue to improve in the long term through creeping attachment.	
	Modified coronally advanced tunnel with subepithelial connective tissue graft	• Well suited for multiple adjacent recession defects. • Superior esthetics compared with free gingival graft. • Possibly less donor site discomfort compared with free gingival graft.	• Less predictable for increasing the dimensions of the attached gingiva compared with free gingival graft. • Does not increase vestibular depth or eliminate aberrant frenal attachments.
Isolated canine recession defect	Double pedicle flap with subepithelial connective tissue graft (bilaminar technique).	• Does not require coronal advancement of the flap. • Limits flap tension. • Takes advantage of relatively wide interdental spaces adjacent to canines.	• Relies upon small, delicate pedicle flaps that may be susceptible to ischemia and necrosis. • Not applicable at sites exhibiting narrow interdental spaces.

Materials and methods

Four mandibular anterior root coverage cases are presented to illustrate preferred techniques for multiple adjacent recession defects (MRDs), isolated incisor defects, and isolated canine defects. In each case, treatment options were discussed in detail, and the patient completed an informed consent process involving verbal and written components.

Case descriptions and results

Case 1 – Raetzke pouch applied at an isolated mandibular incisor recession defect

A systemically healthy 34-year-old male was referred for evaluation of gingival recession in the mandibular anterior region. Examination revealed 90% plaque free surfaces with 15% bleeding on probing. Probing depths ranged from 1 to 3 mm generally, with 4-mm probing depths isolated to the distal surfaces of mandibular second molars. Interproximal radiographic bone levels were approximately 2 mm from the cementoenamel junctions (CEJs) generally. In right and left excursive movements of the mandible, group function was noted bilaterally. Slight supereruption of the mandibular left central incisor through the right canine was appreciated, with slight incisal wear of the incisors. The patient denied parafunctional habits, consistent with clinical observations during the examination. The left mandibular central incisor, which was positioned slightly toward the facial, exhibited 4 mm of gingival recession (RT1A-) and 1 mm of unattached keratinized gingiva. There was no interproximal clinical attachment loss, the CEJ was detectable, and no cervical step was appreciated. The patient elected to proceed with a Raetzke pouch (RP) to treat the isolated recession defect.

Initial intraoral antisepsis was completed using a 0.12% chlorhexidine gluconate rinse for one minute. Following administration of local anesthesia, a pouch was created using a combination of microblades and a small periosteal elevator. The exposed root surface was planed, and minimal odontoplasty was performed with hand instruments to reduce the root prominence and eliminate irregularities. The root was conditioned with 24% ethylenediaminetetraacetic acid (EDTA) (Prefgel, Straumann, Basel, Switzerland) for five minutes.

An epithelialized palatal graft was harvested from the hard palate (right side) and de-epithelialized extraorally. Prior to graft stabilization, an enamel matrix derivative (EMD) (Emdogain, Straumann) was applied to the root surface. The connective tissue graft was stabilized with 5-0 (polyglycolic acid/polycaprolactone (PGA/PCL) sutures. Prior to closure, additional EMD was applied to the superficial layer of the harvested graft. The overlying pouch was stabilized using a single 5-0 sling suture (PGA/PCL). The patient received ibuprofen (800 mg) and acetaminophen (325mg) as needed for analgesia. Healing proceeded uneventfully, resulting in a favorable clinical outcome **(Figure 2)**.

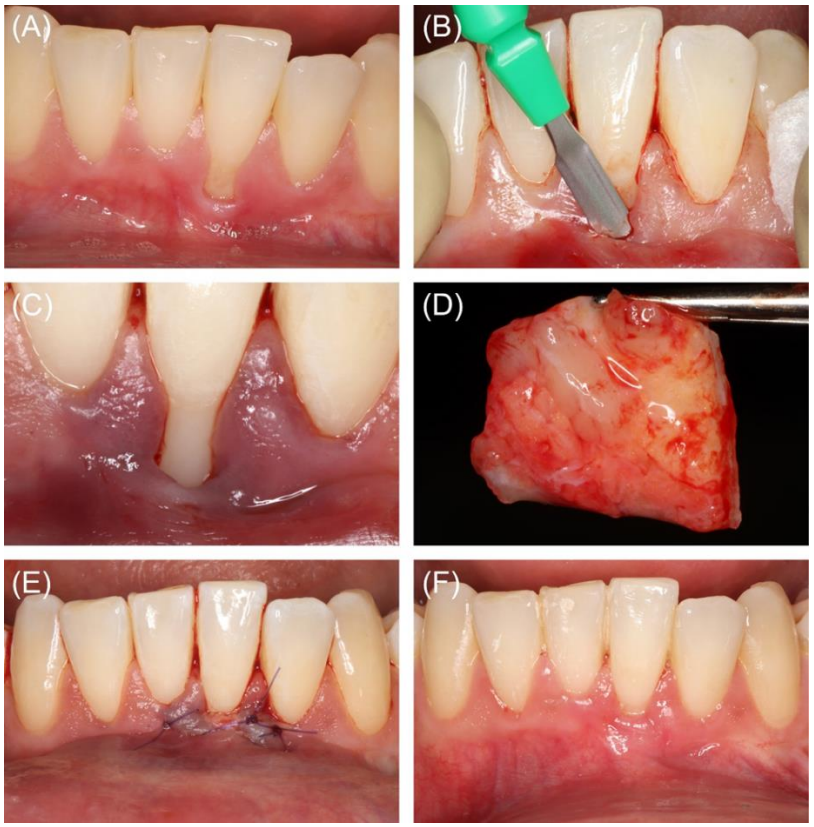

Figure 2. Raetzke pouch technique application at isolated mandibular incisor recession defect. (A) Baseline 3.5-mm recession defect at the left mandibular central incisor site. The tooth was positioned toward the facial and slightly supererupted. (B) A pouch was established using microblades and a small periosteal elevator. (C) The root was thoroughly planed and conditioned with 24% ethylenediaminetetraacetic acid. (D) A 1 x 2 centimeter epithelialized palatal graft was harvested, then de-epithelialized extraorally. (E) The autogenous graft and overlying pouch were stabilized with 5-0 polyglycolic acid/polycaprolactone sutures. (F) At postoperative month two, the residual recession defect amounted to < 1 mm.

Case 2 – Free gingival graft applied to multiple adjacent recession defects in the mandibular anterior

A healthy male aged 25 years complained of cold sensitivity and discomfort while brushing the mandibular anterior teeth. He denied parafunctional habits. The patient's maxillary midline was shifted 3 mm to the left, and in maximum intercuspation, left molar and canine relationships exhibited Class II tendency. In contrast, Class III molar and canine relationships were observed on the patient's right side, and both maxillary left premolars lacked occlusal contacts. Thus, heavy occlusal contacts were found on the mandibular anterior teeth. Radiographic assessment revealed bone loss in the mandibular incisor area, limited to the coronal third of the roots. The mandibular central incisors displayed < 1 mm of attached gingiva, and a prominent labial frenum inserted in the midline. Gingival recession at central incisor sites extended from the facial to the mesial surfaces, and interproximal exceeded facial attachment loss (RT3A-recession). The mandibular lateral incisors exhibited facial recession (RT1A-) with no attached gingiva. The patient displayed a shallow vestibule between the mandibular canines. A free gingival graft (FGG) was planned. The recipient site was carefully prepared by outlining and removing the alveolar mucosa and submucosa, leaving a bleeding bed of connective tissue to promote graft vascularization. Tooth roots were debrided with ultrasonic and hand instruments. A FGG 2 mm in thickness was harvested from the right side of the hard palate. The graft was secured at the recipient bed with a combination of simple interrupted (6-0 polypropylene) and Holbrook-Ochsenbein (5-0 polytetrafluoroethylene) sutures. The frenal tag interproximal to teeth #24 and 25 was excised. The patient received ibuprofen (800 mg) and acetaminophen (325mg) as needed for analgesia. Early healing was uneventful with mild

scarring at the base of the graft. Monthly postoperative visits revealed creeping attachment coronal to the grafted site with progressive midline papilla fill. The patient reported complete resolution of his cold sensitivity and discomfort during toothbrushing **(Figure 3)**.

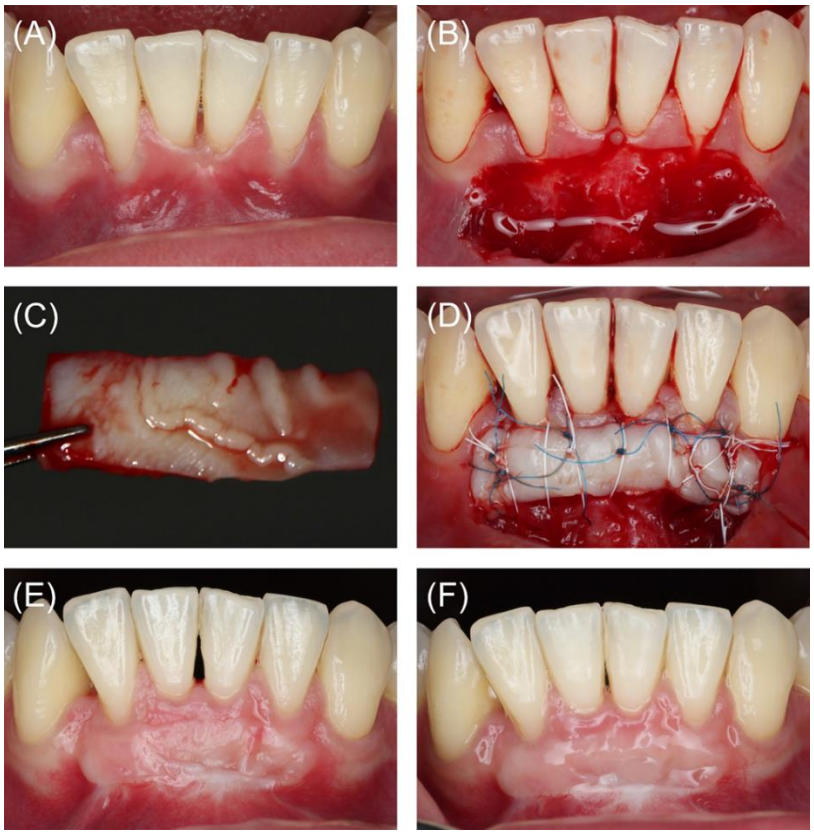

Figure 3. Free gingival graft applied to multiple adjacent recession defects in the mandibular anterior. (A) Baseline clinical appearance. The mandibular incisors exhibited minimal attached gingiva. Some crowding/malocclusion was present. Conspicuous loss of interproximal hard and soft tissue was present between the central incisors. (B) Recipient site prepared. (C) Free gingival graft (FGG) harvested from the right side of the hard palate. (D) FGG stabilized at the recipient site. (E) Postoperative month three. (F) Postoperative month four. Progressive creeping attachment and papilla fill were noted.

Case 3 – Modified coronally advanced tunnel with subepithelial connective tissue graft at multiple adjacent recession defects in the mandibular anterior

A systemically healthy 34-year-old male was referred for assessment of multiple adjacent gingival recession defects in the mandibular anterior region. Upon clinical examination, 91% of dental surfaces were plaque free. The gingiva was pink and firm generally with marginal erythema, edema, and bleeding on probing limited to sites in the mandibular anterior associated with recession. Probing depths ranged from 1 to 3 mm, with isolated 4-mm probing depths at mesial surfaces of the maxillary first molars.

Radiograph survey confirmed interproximal alveolar bone levels approximately 2 mm from CEJs generally. Group function was observed in right and left excursive mandibular movements, and moderate incisal wear was present on all anterior teeth. Gingival recession (RT1A-) was recorded at the right lateral incisor (4 mm), right central incisor (2 mm), left central incisor (3 mm), and the left lateral incisor (2 mm). The apicocoronal width of attached gingiva at the right lateral incisor measured less than 1 mm. No interproximal clinical attachment loss was recorded, and the CEJ was detectable at each recession defect. The patient elected to undergo a modified coronally advanced tunnel combined with a subepithelial connective tissue graft. The procedure commenced with intraoral antisepsis using 0.12% chlorhexidine gluconate for one minute. After local anesthesia was administered, a tunnel flap was carefully created between the mandibular canines using microblades and a small periosteal elevator. Special attention was given to

avoid flap perforation. EDTA root conditioning and application of EMD were completed as described for Case 1. A subepithelial connective tissue graft was harvested from the left side of the hard palate, extending from the canine to the first molar region. The graft was then stabilized between the root surfaces and the tunnel flap. Both the tunnel flap and the graft were secured with a subpapillary continuous sling suture (6-0 polypropylene). Additionally, a single tooth supported sling suture (6-0 polypropylene) was placed to secure the exposed graft on the right mandibular lateral incisor. The marginal tissue was coronally advanced to the CEJ at most sites, while the SCTG remained partially exposed at the left mandibular lateral incisor. Postoperatively, the patient was prescribed ibuprofen (800 mg) and acetaminophen (325 mg) for pain management. The healing process was uneventful, and the early clinical outcome was favorable at one month **(Figure 4)**.

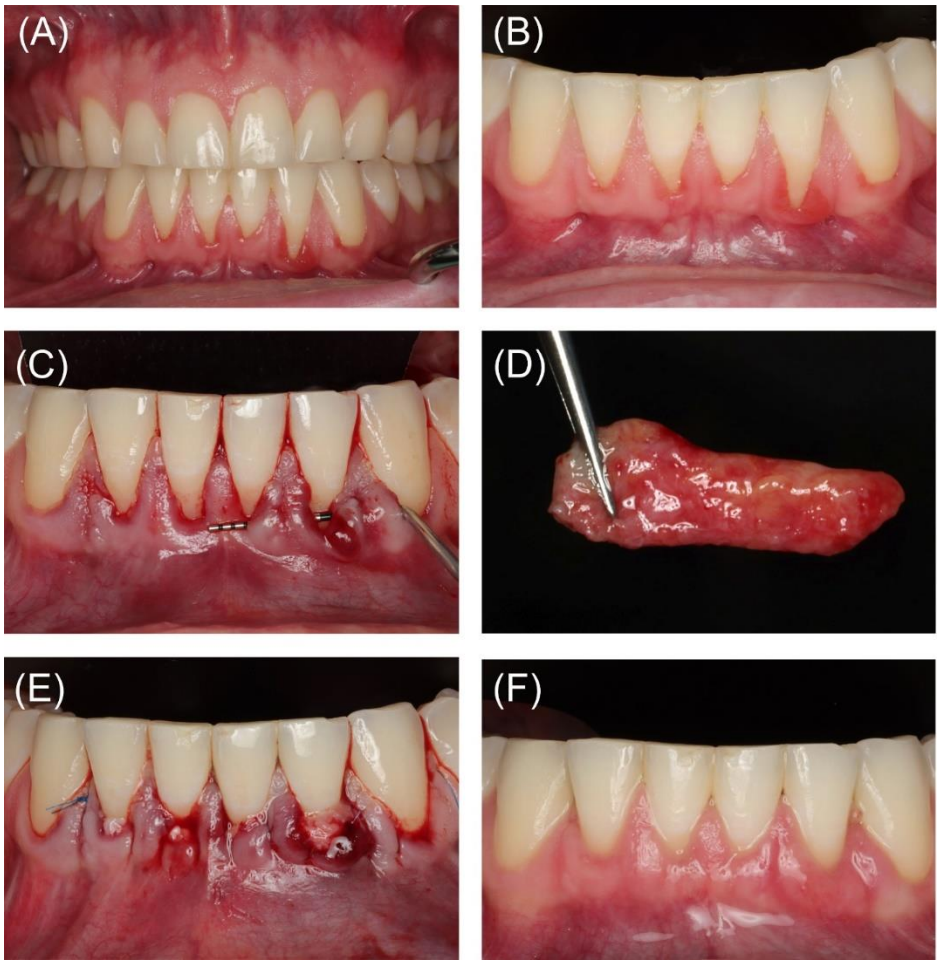

Figure 4. Modified coronally advanced tunnel with subepithelial connective tissue graft (SCTG) applied to multiple adjacent recession defects in the mandibular anterior. (A) and (B) Baseline clinical appearance. The patient exhibited minimal plaque accumulation and marginal erythema at sites of exposed root surfaces in the mandibular anterior. Significant incisal wear and dentoalveolar extrusion were noted, particularly at the central incisor sites. (C) Tunnel prepared at mandibular incisor sites. (D) SCTG harvested. (E) Graft stabilized at recipient site. (F) Postoperative week four.

Case 4 – Double pedicle flap with subepithelial connective tissue graft applied at bilateral mandibular canine recession defects

A systemically healthy male aged 33 years presented with concern over progressive gingival recession at the mandibular canine sites. The patient reported a history of orthodontic therapy and had received a fixed orthodontic retainer from canine to canine in the mandibular arch. The roots of the mandibular canines were vertically positioned, and substantial alveolar dehiscence defects were suspected. In addition, both mandibular canines presented prominent wear facets, although the patient denied parafunctional habits.

Slight gingival recession was also noted at the remainder of the mandibular anterior teeth. However, the patient had no symptoms, and the position of the gingival margin in the incisor area appeared stable over time, as reported by the patient. No interproximal bone or attachment loss was detected, and the recession was classified as RT1A-. The patient elected bilateral double pedicle flap (DPF) with connective tissue graft (CTG) at the mandibular canine recession defects.

At each mandibular canine site, the facial marginal tissue was excised to remove the sulcular epithelium. A mesial papilla flap was mobilized, then sutured to the adjacent attached gingiva before reflection of the distal pedicle. Minimal odontoplasty was performed to reduce root prominence, and roots were planed with hand instruments. Root conditioning and application of EMD were completed as described for Case 1. A CTG was harvested from the right side of the hard palate (canine to first molar area) and divided into two segments. The segments were secured at the CEJs of mandibular canines using modified mattress sutures (5-0 PGA/PCL). The DPFs were stabilized over the CTGs using sling and simple interrupted sutures (5-0 polytetrafluoroethylene). The patient received ibuprofen (800 mg) and acetaminophen (325mg) as needed for analgesia. At postoperative month three, complete root coverage was observed at both sites **(Figure 5)**.

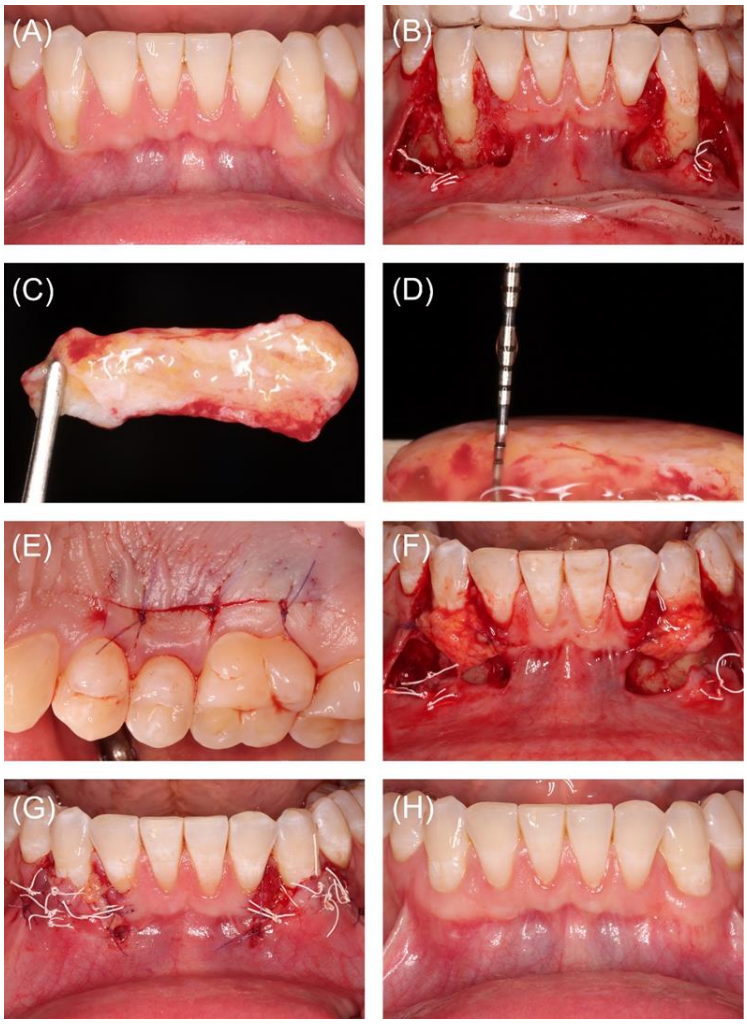

Figure 5. Double pedicle flap with subepithelial connective tissue graft applied at bilateral mandibular canine recession defects. (A) Baseline clinical appearance. The patient's chief complain was progressive recession at mandibular canine sites. The minor recession at incisor positions was not concerning to the patient. (B) Double pedicle flaps mobilized and initial sutures placed. (C) Subepithelial connective tissue graft harvested. (D) Prior to thinning, the graft measured > 3 mm in some areas. The graft was trimmed to achieve a uniform thickness of approximately 2.5 mm. (E) Donor site closed with simple interrupted sutures. (F) Grafts secured at mandibular canine sites. (G) Appearance of sutures at completion of the procedure. (H) Postoperative month three.

Discussion

The purpose of this report was to present rationale for preferred root coverage procedures at multiple-adjacent and isolated recession defects in the mandibular anterior region. Considering the autologous and allogeneic grafts, biologic agents, and flap techniques accessible to the contemporary periodontal surgeon, the treatment options for the described scenarios seem limitless, and existing research does not permit establishment of definitive evidence-based guidelines. Clearly, favorable outcomes were achievable in the presented cases using any of numerous surgical techniques, and among experienced clinicians, disagreements on the ideal methodology will inevitably occur. Nevertheless, important clinical decisions under such conditions are unavoidable, and each treatment option offers both drawbacks and advantages. This report did not aim to comprehensively review every available root coverage technique. Rather, advantages of specific techniques were compared against surgical challenges encountered at isolated and multiple-adjacent recession defects in the mandibular anterior. Emerging state-of-the-art technologies were intentionally disregarded, and the incremental benefit of combining the described procedures with biologics such as EMD, platelet-derived growth factor, and platelet rich fibrin fell beyond our scope. Among techniques in widespread clinical use, the RP, FGG, MCAT, and DPF + CTG procedures appear well suited for specific clinical scenarios that periodontal surgeons face routinely.

The isolated mandibular incisor recession defect often presents a dilemma for the periodontal surgeon. In addition to recession, the site may exhibit little or no attached gingiva as well as localized plaque accumulation and inflammation. Clear indications for root coverage may be present, and the patient may communicate strong desire for treatment. However, the adjacent teeth may demonstrate pristine periodontal attachment and no recession. Any root coverage procedure involving a mucoperiosteal flap—even a tunnel procedure—disrupts the attachment on the adjacent teeth and risks iatrogenic tissue damage. Where the alveolar bone is thin, flap reflection is known to result in about 1 mm of reduction in crestal bone height **[14-16]**. Thus, bone resorption and the possibility of inducing recession at adjacent sites is a concern.

The RP (envelope) technique for isolated recession defects was introduced in 1985 **[17]**. For MRDs, the RP procedure is inefficient and less predictable than alternative methods **[3,4]**. However, at sites of mandibular incisor recession, RP may be the technique least likely to disturb periodontal attachment at adjacent teeth. Moreover, the graft dimensions required for RP are minimal, possibly limiting postoperative morbidity for the patient **[18,19]**. The simplicity of the flap design promotes efficient completion of the procedure, which may also contribute to an uneventful postoperative course.

Multiple procedures involving autogenous and allogeneic soft tissue grafts are available for treatment of MRDs in the mandibular anterior. However, the FGG addresses anatomic factors limiting root coverage in this anatomic region and offers several important clinical advantages. Although FGGs typically return less favorable esthetic results compared with CTG-based procedures, most patients do not display mandibular anterior gingiva when speaking or smiling **[20]**. Diminutive vestibular depth is often a challenge in mandibular anterior root coverage procedures. Preparation of the FGG recipient bed permits deepening of the vestibule and elimination of aberrant frenal attachments **[8,21]**. Moreover, limited evidence suggests that clinical results following FGG may, in some cases, continue to improve over observation periods of years or decades **[22,23]**. In addition, the FGG remains the gold standard for increasing attached gingival dimensions **[24]**.

Although the FGG offers multiple advantages relevant to root coverage in the mandibular anterior, some patient- and site-related factors may steer the clinician away from this treatment. When patient-oriented outcomes such as esthetics and postoperative discomfort are paramount, FGG may be a poor choice. Likewise, at sites exhibiting adequate vestibular depth and dimensions of attached gingiva, the drawbacks of the FGG may outweigh the benefits. In such cases, the MCAT + SCTG is a useful alternative. The MCAT + SCTG is technique sensitive, particularly when the phenotype is thin, and although the procedure is likely to increase the marginal tissue thickness and the zone of attached tissue, it appears inferior to FGG in this regard **[24]**.

Specific site-related factors impede root coverage success at mandibular canine recession defects. Alveolar dehiscence defects, which present large, avascular root surfaces that limit blood supply to autogenous and allogeneic grafts, are common at these sites **[10]**. Moreover, the zone of attached gingiva narrows in this area of curvature in the mandibular arch **[25]**. Fortunately, relative to mandibular incisor sites, interproximal papillae adjacent to canines are comparatively wide **[9]**. Thus, when the DPF technique is utilized, the established interproximal pedicle flaps are more substantial and have greater surface area for blood supply. Combining the DPF with SCTG **[26]** significantly increases the reliability of the procedure and the stability of the results **[27]**.

General complications associated with root coverage surgery can occur following any of the procedures highlighted in this report. These include hemorrhage from the palatal donor site, flap/graft necrosis, residual dentinal hypersensitivity, pain, and swelling **[28]**. Discomfort from FGG harvest sites may exceed discomfort from SCTG harvest sites, **[29]** and the discomfort has been shown to correlate with graft dimensions **[30]**. Procedures involving implantation of SCTG beneath mucoperiosteal flaps can result flap perforation during surgery **[28]** and late complications such as epithelial cell discharge, gingival cul-de-sac formation, and cystic lesions **[31]**. Exostosis formation and external root resorption are other late complications that can occur following autogenous soft tissue grafting **[1,32]**. Ultimately, root coverage technique selection should result from a shared decision-making process involving the patient and the clinician. Specific patient- and site-related factors that are present must be carefully appraised, and the patient must understand the risks, benefits, and potential complications of each feasible treatment option. Depending upon patient desires and relevant clinical factors, personalization of care may compel use of a technique not represented in this report.

Limitations of this report should be emphasized. Due to the high mobility of our patient population, long-term follow-up was not possible. In addition, our report provides no new information regarding the relative predictability of root coverage techniques applied in the mandibular anterior area. Controlled clinical studies comparing mandibular anterior root coverage outcomes are needed. Data from such research will provide evidence on which to base technique selection when treating isolated and multiple-adjacent recession defects in this anatomic region. The focus of this report was to describe our decision-making process in common clinical scenarios for which existing research is lacking.

Conclusion

Patients exhibiting multiple-adjacent and isolated recession defects in the mandibular anterior are frequently encountered in clinical practice. In this report, preferences toward specific root coverage procedures for these clinical scenarios are explained. Each patient presents a unique set of clinical and personal considerations, and treatment options are not constrained to those presented here. Nevertheless, the rationale presented for application of RP, FGG, MCAT + CTG, and DPF + CTG in the described clinical circumstances appears applicable in many cases. Considering these treatment options, when indicated, may help practitioners optimize clinical and patient-reported outcomes while limiting postoperative morbidity.

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