VISTA Approach in Conjunction with Enamel Matrix Derivative, Corticocancellous Bone, and Connective Tissue Graft for Periodontal Defect Surgery: A Case Series

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The biggest challenge during periodontal regeneration in the anterior region is the prevention of soft tissue recession. Minimally invasive surgeries, particularly papilla preservation techniques and soft tissue augmentation, may significantly reduce such postoperative soft tissue recession. This article presents the vestibular incision subperiosteal tunnel access (VISTA) approach for periodontal regeneration in the anterior region. A subperiosteal tunnel prepared from a single vertical vestibular incision adjacent to the defect is used for debridement, application of enamel matrix derivative, defect grafting with corticocancellous tuberosity bone, and insertion of the connective tissue graft. Evaluation of six cases with up to 6 years of follow-up showed improvements in all clinical parameters. The probing pocket depth improved from 8.2 mm ± 0.75 mm initially to 2.7 mm ± 0.52 mm at follow-up, clinical attachment level improved from 8.5 mm ± 0.83 mm initially to 2.7 mm ± 0.52 mm at follow-up, and midfacial gingival recession of 1 mm at two sites was corrected. The papillae were stable at all sites, with an average distance of 4.8 mm from the incisal edge to the papilla tip. This technique seems to be a promising approach for achieving both esthetic and functional goals of periodontal regenerative surgery. However, experience in performing microsurgeries and harvesting tuberosity tissues may be a limitation.
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The treatment of periodontal intraosseous defects using bone grafts, barrier membranes, biologic agents, and combination therapies can result in periodontal regeneration/repair.[1,2] Even after improvement in clinical parameters such as clinical attachment level (CAL), probing pocket depth (PPD), bleeding on probing (BOP), and radiographic bone height, patients are often disappointed with the final esthetic result because of the soft-tissue recession in the treated area. Patients with high smile lines, thin gingival phenotypes, loss of interdental papilla, or > 6 mm tooth contact-interproximal bone crest distance and high esthetic expectations represent a population with a high esthetic risk.[3]

The most common complication of periodontal regenerative surgery is wound dehiscence. Exposure of the bone substitute material, particularly of the guided tissue regeneration (GTR) membrane, leads to inflammation, graft and adjacent bone resorption, and eventually soft-tissue recession.[4–6]

A recent systematic review reported similar flap dehiscence rates in sites treat with GTR and enamel matrix derivative (EMD).[7] EMD is an intensively researched biomaterial with histologically proven regenerative capabilities.[8] The sole use of autologous materials, known to have a potential for regeneration of functional attachment, without membranes can prevent inflammation and resorption due to foreign body reaction.[2]

Because of its fast resorption, particulate autologous bone is used with slow-resorbable biomaterials.[9] However, for implant site development, corticocancellous tuberosity bone (CCTB), wedged into buccal cortical defects of extracted teeth with missing buccal cortical plates has been shown to act as a biologic membrane and maintain the ridge contour in the long term.[10] To our knowledge, CCTB has not yet been used for periodontal regeneration. Harvesting the hard and soft tissues of the tuberosity causes minimal donor site morbidity.[11] The addition of a connective tissue graft (CTG) can compensate for postoperative soft tissue recession.[12,13]

However, the surgical technique is crucial for defect resolution and soft tissue stability. Flap designs have evolved toward minimally invasive approaches characterized by limited mesiodistal extension of the primary incision, limited flap reflection, and avoidance of release incisions.[14–17] Nonetheless, the presence of a suture line in the papilla (tip of the papilla or the base) constitutes a risk for dehiscence. Marginal flap elevation and papilla dissection and elevation can trigger bone resorption, and consequently soft tissue recession.[18] An intact papilla promotes ease of suturing, firm graft fixation, and maintenance of esthetics in the anterior region.[19] A surgical approach that maintains the integrity of the papilla can be beneficial, such as the Whale's tail technique, nonincised papillae surgical (NIPS) approach, entire papilla preservation technique, or modified vestibular incision subperiosteal tunnel access (M-VISTA) approach.[20–24]

The VISTA approach was originally introduced to treat gingival recession but was later used for surgically facilitated orthodontic therapy.[25,26] This technique entails making vertical incision(s) in the vestibule followed by subperiosteal elevation of tunnels.

This clinical report describes the VISTA approach with CCTB grafting procedures after debridement and EMD application in conjunction with CTG for periodontal regeneration/reconstruction and marginal soft tissue maintenance in the anterior region.

Clinical Report

We present the analysis of a case series of five systemically healthy patients (four women and one man; age range, 37 to 54 years) with six intrabony periodontal defects. Consecutive patients were included with clinically and radiographically documented preoperative and at least 6 months of follow-up data after intrabony periodontal defect surgery using the VISTA approach in conjunction with EMD, CCTB, and CTG. One patient who was a light smoker (< 10 cigarettes daily) quit smoking before the surgery, while other patients were nonsmokers. All defects in the patients were combined defects with three-wall components in the apical part of the defect and two-wall components in the superficial parts composed of lingual and proximal bone walls and a missing buccal cortical plate on the affected root.

All surgical procedures were performed by a single surgeon (S.P). All patients provided informed consent for the surgery, data collection, and publication of intraoral photographs.

Two weeks preoperatively, each patient received individualized professional oral hygiene instructions and underwent full mouth supra- and subgingival scaling using ultrasonic scalers and periodontal curettes and polishing. Subgingival scaling was performed for sites with PPDs > 3 mm, except teeth scheduled for periodontal surgery to avoid possible postoperative tissue recession. All patients were enrolled in a periodontal maintenance program.

We present two representative cases managed using the VISTA approach (Figs 1 and 2). A periodontal probe was inserted in the gingival sulcus of the right central incisor to locate the periodontal pocket (Fig 1a). A vestibular vertical access incision was placed on the gingiva of the adjacent teeth to the underlying bone, as close to the defect as possible, extending from 3 mm from the sulcus of the involved tooth to beyond the mucogingival junction. Periosteal elevators were used to prepare the subperiosteal tunnel extending to one tooth and interproximal area mesial and distal to the defect (Fig 1b). The sulcular approach was used to undermine the entire thickness of the papilla with a papilla elevator (Fig 1c). The periosteal elevator was used to connect the subperiosteal tunnel prepared from the vestibular incision and the subperiosteal papillary tunnel prepared from the sulcus. The buccal soft tissue was released sufficiently to be displaced coronally.

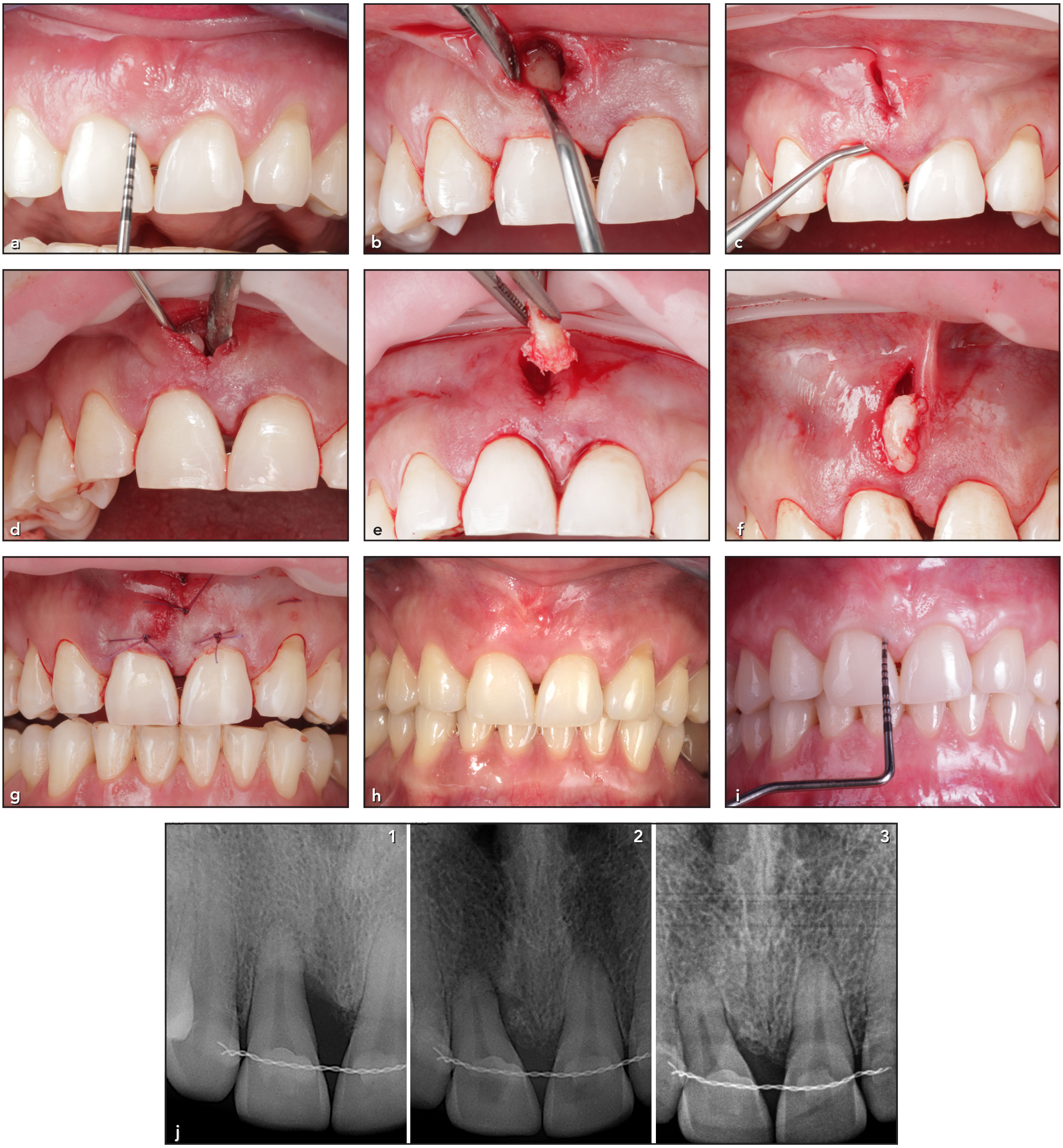

Fig 1 *Case 1.* (a) *Probing before surgery. Note the swelling in the vestibule corresponding to the periodontal defect.* (b) *The root and defect were accessed using the vestibular incision subperiosteal tunnel approach. Note the missing buccal bone in the central incisor region.* (c) *The papilla was undermined using a sulcular access with a papilla elevator.* (d) *Application of EMD.* (e) *Pre-shaped corticocancellous tuberosity bone before it is pressed into the defect.* (f) *CTG inserted into the tunnel.* (g) *Coronal advancement of the buccal soft tissue.* (h) *Healing 2 weeks after the surgery.* (i) *Probing depth of 3 mm; no BOP 18 months after the surgery.* (j) *Radiograph before the surgery showing a periodontal defect with 45-degree baseline angle (1), immediately after the surgery (2), deposition of hard tissue in the defect 18 months after the surgery (3).*

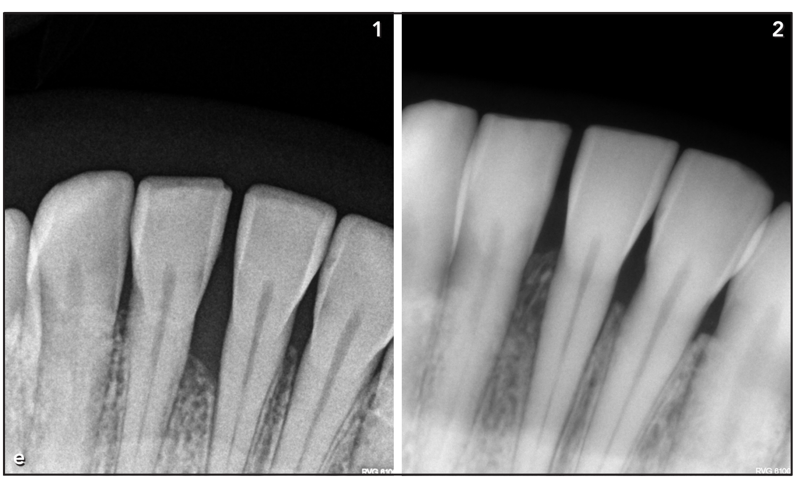

Fig 2 *Case 2.* (a) *Exposure of the periodontal defect using the vestibular incision subperiosteal tunnel approach.* (b) *Corticocancellous tuberosity bone pressed into the defect.* (c) *CTG inserted to enhance buccal soft tissue volume and protect the bone graft.* (d) *Clinical condition at the 9-month follow-up.* (e) *Initial and 9-month follow-up radiographs, showing hard tissue deposition in the defect.*

Defect debridement and root scaling and planing were accomplished from both vestibular and sulcular access sites using ultrasonic scalers and periodontal curettes. Root planing was performed ensuring that the roots were smooth and the attachment of the periodontal fibers to the root cementum was not disturbed. Sterile saline was used for irrigation.

Both CTG and CCTB were harvested from the tuberosity. A vertical releasing incision was placed on the mesiobuccal aspect of the terminal tooth, and an intrasulcular incision was made on the buccal surface and extended posteriorly to the mid-crestal region (Fig 3a). Posteriorly, in the tuberosity area, an incision 1 mm in depth was placed. The blade was then angulated to split the buccal aspect of the soft tissue of the tuberosity buccally. A full-thickness buccal flap on the terminal tooth and a partial-thickness flap in the tuberosity area were elevated. The soft tissue of the tuberosity was de-epithelized using a blade, bur, or laser (Fig 3b). The distal connective tissue wedge was harvested as described in the

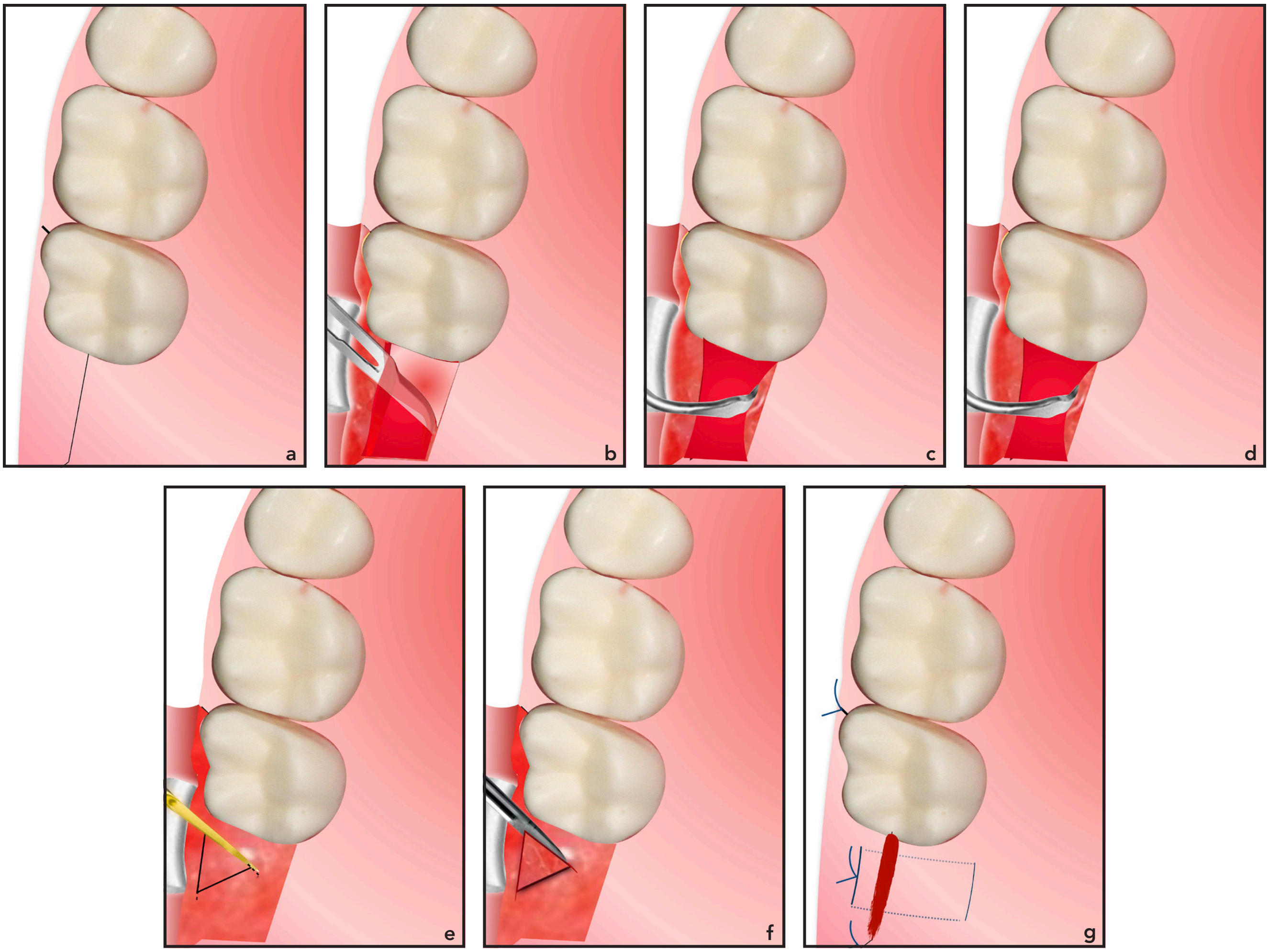

Fig 3 *Step-by-step procedure for harvesting CTG from the tuberosity and CCTB. (a) Incision design. (b) De-epithelization of tuberosity soft tissue following elevation of a full-thickness flap in the region of the terminal tooth and a partial-thickness flap in the tuberosity region. (c) CTG harvested using a periodontal chisel after performing tissue dissection using an incision from the distopalatal line angle of the terminal tooth perpendicular to the bone and parallel to the first tuberosity incision. (d) A piezoelectric device used to cut the bone. (e) A piece of CCTB outfractured using bone chisels. (f) Horizontal mattress and single-interrupted sutures for wound closure.*

literature, and the tuberosity bone was exposed (Fig 3c).[27] Osteotomy cuts were created using piezoelectric saws, according to the periodontal defect site (Fig 3d). The depth of the cuts and the CCTB block size were slightly larger than the defect to be augmented. The CCTB block was mobilized, not fractured completely, using bone chisels and retained in the bone envelope, until the surface treatment of the exposed root was completed (Fig 3e).

The root was conditioned using 24% ethylenediaminetetraacetic acid gel for 2 min, followed by rinsing with sterile saline and EMD application (Fig 1d). The root surface was ensured to be free of blood to allow better adsorption of EMD on the root surfaces.[28] Immediately following EMD application, the CCTB piece was fractured, shaped using bone forceps, and pressed into the defect using a periosteal elevator and wet gauze (Fig 1e). The tuberosity bone is malleable, and when pressed into the defect, it adapts and retains stability. The gaps between the CCTB block and the defect were filled with the particulate bone harvested from the tuberosity using bone forceps.

CTG was inserted into the subperiosteal tunnel (Fig 1f). Closure of the vertical incision and fixture of the CTG to the buccal flap were achieved simultaneously using 6-0 monofilament sutures (Fig 1g). The

Table 1 Initial and Follow-up Clinical Parameters

	Tooth no.*	Follow-up	PPD, mm		CAL, mm		Gingival recession, mm		Incisal edge/papilla tip distance, mm	
			Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up
Site 1	11	18 mo	8	2	9	2	1	0	4.5	4.5
Site 2	31	9 mo	8	3	8	3	0	0	4.5	4.5
Site 3	11	73 mo	9	3	9	3	0	0	5	5
Site 4	13	12 mo	9	3	9	3	0	0	5	5
Site 5	23	28 mo	7	2	7	2	0	0	4.5	4.5
Site 6	21	46 mo	8	3	9	3	1	0	5.5	5.5
Mean ± SD		31 mo	8.2 ± 0.75	2.7 ± 0.52	8.5 ± 0.83	2.7 ± 0.52	0.3 ± 0.52	0	4.8 ± 0.37	4.8 ± 0.38

*FDI tooth-numbering system. **[Au: Please verify all tooth numbers are correct after converting to the FDI system.]**

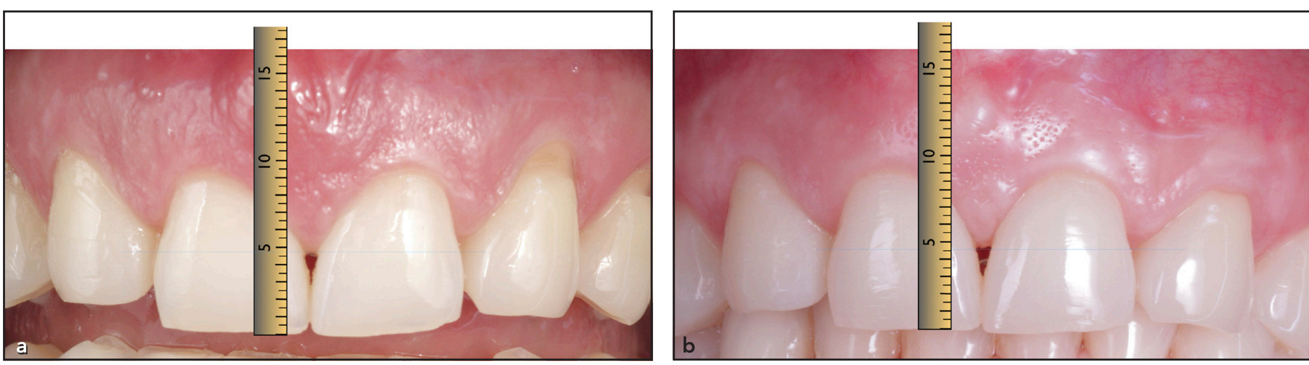

Fig 4 *Evaluation of changes in papillary height on calibrated images. Incisal edge of the treated tooth used as a reference line.*

buccal flap was advanced and fixed coronally. The tuberosity donor area was sutured (Fig 3f). A similar procedure was performed in the region of mandibular incisors (Fig 2). The operative time was 40–50 min, depending on the defect size and tuberosity accessibility.

Postoperative Instructions

All patients were prescribed systemic amoxicillin (500 mg thrice daily for 5 days) and instructed to clean the surgical area using cotton swabs. After 2 weeks, the sutures and supragingival plaque were removed, and oral hygiene instructions were reinforced (Fig 1h). The patients were allowed to brush their teeth using a soft brush and the roll technique 2 weeks postoperatively.

Measurements

Clinical parameters such as PPD, measured from the level of the marginal gingiva to the bottom of the periodontal pocket; CAL, measured from the cementoenamel junction to the bottom of the pocket; gingival recession, measured at the midfacial aspect of a tooth from the cementoenamel junction to the gingival margin; and local BOP were recorded at baseline, 6 months postoperatively, and according to individual patient requirements thereafter. A periodontal probe calibrated in millimeters was used for the measurements. Distances were measured in millimeters and rounded to the next number if the measurement was equal to or past the halfway point between the readings. PPD and CAL were recorded at six sites per tooth: mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual. The deepest pocket measurements are shown in Table 1.

Intraoral photographs were taken at the last follow-up visit (Fig 1i). The distance from the incisal edge to the tip of the papilla of the affected tooth was measured on calibrated initial and follow-up intraoral photographs. Image calibration was performed as described in the literature (Fig 4).[29]

Intraoral radiographs were obtained preoperatively, immediately postoperatively, and at follow-up visits, depending on individual patient requirements (Fig 1j).

Clinical Outcomes

No adverse events were noted at any site. At suture removal (2 weeks postoperatively), all sites exhibited adequate primary wound healing at the vertical incision with no fibrin line. The interdental papilla was preserved in all cases, and improvement was evident in all clinical periodontal parameters. The preoperative midfacial recession of 1 mm was successfully treated during the periodontal defect surgery in two cases. The patients were followed up for 9–73 months, with an average follow-up period of 30 months. Table 1 shows the baseline and follow-up values of the clinical parameters for the six treated teeth.

Discussion

Flap designs that permit access to the periodontal defect without placing an incision in the papilla reduce the risk of wound dehiscence in the interproximal and marginal areas, reducing the incidence of the postoperative papilla and/or marginal gingival recession.[20–24] In the NIPS technique, a horizontal incision is made in the mucosa and a full-thickness flap is elevated coronally to access, debride, and graft the defect.[21,22] The M-VISTA technique entails two vertically oriented incisions, one or two teeth mesial and distal to the defect area, similar to the VISTA design proposed for surgically facilitated orthodontic therapy.[24,26] The vertical incision in the mucosa is parallel to the course of blood vessels, reducing the risk of injury and maintaining blood supply. Additionally, since muscles are not interrupted, unlike in the horizontal incision, when placed in nonattached mucosa, suture line tension decreases.

We used a single vertical incision just adjacent to the defect for gaining access and sulcular approach for root scaling. Visualization of the treated area was sufficient. One midline frenulum incision is reported to be sufficient for mobilizing the mucoperiosteum of six anterior teeth.[25]

Incisions near the grafted area may pose a risk of graft material exposure and exfoliation. In this case series, we did not encounter any case of wound dehiscence and graft failure because of limited tension on the vertical incision and the autologous nature of the grafting materials. Additionally, unlike the papilla incision techniques, plaque is not formed near the suture line during early wound healing.

In this case series, autologous tissue was used in conjunction with EMD. EMD has demonstrated enhancements in bone and soft tissue healing by inducing proliferation, migration, adhesion, mineralization, and differentiation of cells in the periodontal tissue.[8]

All sites were augmented using CCTB pieces wedged into the defects. The cortical tuberosity bone oriented buccally acts as a biologic barrier membrane, as in immediate dentoalveolar restoration, a technique that uses CCTB to reconstruct the missing buccal bone during tooth extraction.[10] The corticocancellous composition of the graft seems to be advantageous because the cancellous bone has excellent cellular diversity and activity, whereas cortical bone has enhanced mechanical properties.

CTG was used to enhance the thickness of marginal soft tissue, support the papilla, and reduce the risk of postoperative soft tissue recession. It is reported that the clinical outcome of recession coverage is not affected by the orientation of CTG.[30] In this case series, CTG was oriented randomly either with periosteum facing the graft or the flap. In two cases, the pre-existing gingival recession was treated successfully during periodontal surgery.

Donor site morbidity is associated with the harvesting of autologous materials. However, pain and complications after harvesting of tuberosity bone and CTG have been reported as minimal.[11] Limited amounts of hard and soft tissues of the tuberosity are present in almost all patients; CTG can be enlarged by slicing and unfolding. Alternatively, palatal CTG can be used.

Supragingival scaling was performed 2 weeks preoperatively. Subgingival scaling was not performed for the teeth scheduled for surgery to avoid possible postoperative tissue recession.

This technique has some limitations. The applicability of the technique is limited to periodontal defects with intact lingual bone in the anterior and premolar areas. Accessing the tuberosity soft and hard tissues can be difficult, or the quantity of the tuberosity tissue can be compromised, particularly in cases where wisdom teeth are present. The limitations of the case analysis are the small number of examined sites and the retrospective nature, without the inclusion of a control group. Furthermore, in this analysis, the amount of defect fill could not be assessed on radiographs because of the lack of radiograph standardization.

Conclusions

Within the limitations of this analysis, we concluded that the VISTA approach in conjunction with EMD, CCTB, and CTG is a promising technique for the regeneration/repair of periodontal defects with intact lingual bone. Stable surgical wounds, closed environments, stabilized mechanical forces, and optimum blood supply provide a framework for regeneration using autologous CCTB and EMD. Additionally, CTGs compensate for postoperative tissue recession. This case series demonstrates the potential efficacy of the presented technique, which should be evaluated in a greater number of treated sites through well-designed studies.

Acknowledgments

[Au: Please provide a conflict of interest statement.]

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