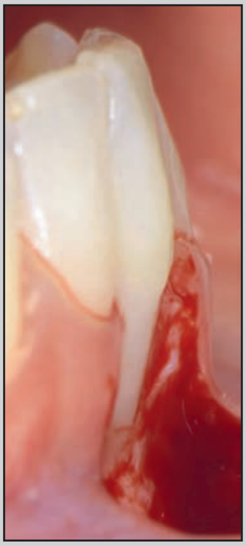

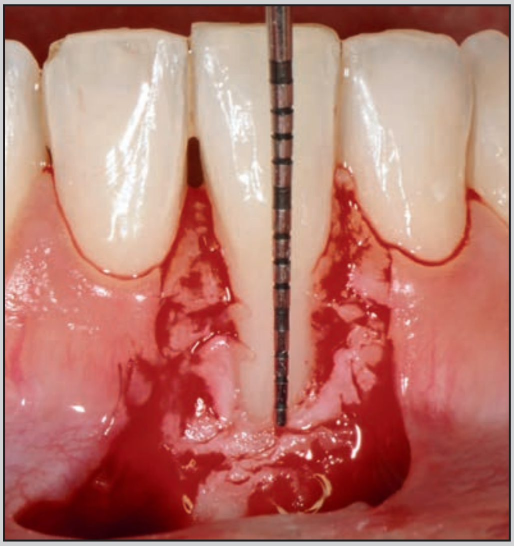

Treatment of Deep Isolated Gingival Recession Defects Affecting Mandibular Incisors: A Novel Interdisciplinary Orthodontic-Mucogingival Approach

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Tooth malposition negatively affects the outcome of root coverage procedures, limiting chances for complete root coverage (CRC). This case series introduces a combined orthodontic-mucogingival approach for the treatment of deep (> 4 mm) isolated gingival recession defects affecting mandibular incisors with a buccally displaced root. Twenty patients were treated with a novel orthodontic device (FZ Root Torque Controller) for selective correction of tooth malposition at the affected site, turning all isolated recessions into Miller Classes I and II. Subsequent surgical treatment of the gingival recession with a vertically-coronally advanced flap plus a connective tissue graft achieved 90% CRC at the 1-year follow-up, with a recession reduction of 5.6 ± 1.5 mm, a 1.24 ± 0.24 mm increase in gingival thickness, and improved esthetic outcomes. Int J Periodontics Restorative Dent 2022;42:25–33. doi: 10.11607/prd.5404

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One of the most important predisposing factors for the development of gingival recession (GR) is undoubtedly the presence of bone dehiscence, most of the time related to the position of the tooth outside of the bony housing. In the mandibular incisors, known for naturally having a thin buccal bone plate, this condition can also be associated with previous orthodontic movements,[1,2] lingual fixed retainers,[3–5] a variety of parafunctional oral habits,[6] thin gingival phenotype,[7] frenal pull, suboptimal oral hygiene and improper tooth brushing, or a combination of these factors.[8]

Amidst the wide range of presentations of GRs, some cases warrant presurgical treatments to improve surgical root coverage (RC).[8] Whenever an isolated GR must be treated on a tooth with a severe buccal root displacement, orthodontic therapy executed prior to any surgical attempt to resolve the recession will make said approach more predictable,[9,10] resulting in a long-lasting and highly esthetic outcome.[11] From an orthodontic point of view, single tooth movements are challenging, especially in the following scenarios: when there is no desire/indication for alteration of the position of adjacent teeth; when correction of tooth torque will also cause undesired movements of the tooth itself (extrusion, intrusion, proclination); and finally, when a deep overbite prevents adequate placement of standard appliances. As a result, a classical orthodontic approach involving both dental arches is often chosen, increasing the time and costs of the therapy.

The aim of this case series is to introduce a novel interdisciplinary orthodontic-mucogingival approach for treatment of deep isolated GR defects affecting mandibular incisors with buccally displaced roots.

Materials and Methods

Twenty patients (7 men and 13 women, mean age: 32 ± 9 years) affected by an isolated GR defect on a mandibular incisor were included in the case series. Subjects were selected from individuals referred to a private periodontal practice (G.Z.) between 2015 and 2017. All of the participants met the following inclusion criteria: adult patients (≥ 18 years old); systemically healthy; having one mandibular incisor presenting deep (≥ 5 mm) GR combined with severe buccal root displacement and different angulation with respect to the adjacent teeth in the occlusal view; and full-mouth plaque score[12] (FMPS) and full-mouth bleeding score (FMBS) < 15%.

Reasons for exclusion were: smoking habit (> 10 cigarettes/day), systemic conditions (ie, diabetic, undergoing treatment with drugs responsible for gingival enlargement, or any contraindication for periodontal surgery), and recession defects associated with caries, noncarious cervical lesions, or pathologic interproximal periodontal probing (> 4 mm). Selected patients were informed of the aims of the therapy, the nature of the surgical procedure, and the importance of compliance with oral hygiene practices and attendance to recall appointments. Upon agreement, subjects signed a consent form and were enrolled in the study. An initial prophylaxis session was performed, including detailed instructions for proper oral hygiene.

Clinical, Esthetic, and Patient-Reported Outcomes

The following clinical measurements were performed at the midbuccal aspect of the treated teeth, recorded at baseline (T0), at the end of the retention phase after active orthodontic therapy (T1), and 1 year after surgical therapy (T2):

- Gingival recession depth (GR-D), measured from the cementoenamel junction (CEJ) to the gingival margin (GM)
- Gingival recession width (GR-W), measured horizontally at the level of the CEJ
- Probing depth (PD), measured from the GM to the bottom of the sulcus
- Clinical attachment level (CAL), measured from the CEJ to the bottom of the sulcus
- Keratinized tissue height (KTH), measured from the GM to the mucogingival junction (identified by means of Lugol staining)
- Gingival thickness (GT), determined 1.5 mm apical to the GM and measured with a digital caliper accurate to the nearest 0.1 mm[13]

Recession type according to Miller's classification[14] was assigned at baseline and updated after completion of orthodontic therapy; the Cairo classification[15] could not be used, as it does not take tooth malposition into consideration. Intraoperatively, the depth of bone dehiscence (BD) was measured vertically (BD-D) as the distance from the CEJ to the buccal bone crest, while the width of BD was measured horizontally (BD-W) as the mesiodistal dimension at the level of the CEJ.

All parameters were collected by a single-masked examiner (M. Stefanini) who did not perform the orthodontic or surgical therapies. Except for GT, all measurements were made with a manual probe (PCP UNC-15 tip, Hu-Friedy) and rounded up to the nearest millimeter.[16] Complete root coverage (CRC) was evaluated 1 year after surgery and scored dichotomously. At the 1-year recall (T2), assessment of the esthetic outcomes was performed by a blind examiner (M. Stefanini) by implementation of the root coverage esthetic score (RES).[17] Also at T2, patient-reported esthetic satisfaction was measured on a visual analog scale (VAS), ranging from 0 to 10 cm (0 = completely unsatisfied; 10 = fully satisfied).[18]

Site-Specific Presurgical Oral Hygiene

In addition to periodic full-mouth prophylaxis, all participants underwent

Fig 1 *Baseline* (a) *buccal and* (b) *occlusal views of a mandibular left central incisor with a deep gingival recession and marked buccal root displacement. Notice the plaque and calculus deposits and inflamed gingival tissues.* (c) *Buccal and* (d) *occlusal views of the situation 2 weeks after the prophylaxis session, showing improved plaque control and healthy gingival tissues. Recession depth was 6 mm, with a 3-mm probing depth (clinical attachment level: 9 mm).*

a site-specific session 2 weeks before beginning orthodontic therapy, consisting of removing the supra and subgingival plaque (thin ultrasonic points) and polishing the exposed root surface (rubber cup and prophylaxis paste). Patients were instructed to locally apply a chlorhexidine-based rinse (0.12%) twice a day and to perform the roll brushing technique with a soft-bristled toothbrush (Fig 1).

Presurgical Active Orthodontic Phase

Orthodontic treatment was performed with the novel device FZ (Fadda/Zucchelli) root torque controller as follows: a 0.19 × 0.25–inch steel archwire was adapted and bonded on the buccal surface of the mandibular anterior teeth (up to the first premolar on either side, except for the target tooth). The steel archwire was fixed with flowable composite resin (Filtek Supreme Flowable Restorative, 3M ESPE), taking care that neither the resin nor the arch interfered with normal occlusion or created premature contacts with the maxillary teeth. Afterwards, a 0.6-mm–diameter orthodontic tube was cemented with flowable composite resin (Filtek Supreme Flowable Restorative) in the most coronal part of the lingual surface of the target tooth. This tube acted as the center of rotation for said tooth by housing a round, 0.20-inch archwire that was splinted lingually on the adjacent teeth. The tube, and therefore the tooth, can rotate freely around this steel wire. The force that produced the lingual movement of the root was represented by a Warren (root torque) spring, which was inserted into the buccal 0.19 × 0.25–inch steel arch wire before its bonding. The spring, placed at the level of the tooth with GR, exerted its force buccally at the most apical portion of the tooth's clinical crown, or sometimes even on the buccal root surface corresponding to the GR. As previously stated, the fulcrum for the tooth's rotation was the round 0.20-inch steel archwire acting through the 0.6-inch tube placed lingually, in proximity to the incisal edge of the target tooth. In this way, it was possible to correct the root position of the tooth affected by GR without altering the position of the adjacent teeth. The active orthodontic phase lasted approximately 5 to 6 months (Fig 2).

Postorthodontic Retention Phase

Once the desired root movement was achieved, the FZ Root Torque Controller was removed, and a fixed lingual retainer was placed to splint

Fig 2 (a) *Buccal view of the FZ Root Torque Controller orthodontic device with the Warren spring acting on the target tooth.* (b) *An occlusal view shows the orthodontic tube bonded to the target tooth, with the round archwire acting as a fulcrum for the tooth's rotation.* (c) *Clinical situation at the end of active orthodontic treatment and* (d) *at the end of the retention phase. Notice improved marginal keratinized tissue. Recession depth was reduced to 4 mm, with a 1-mm probing depth (clinical attachment level: 5 mm).* (e) *Occlusal view before orthodontic treatment and* (f) *at the end of the retention phase. The tooth position was corrected, matching the position of the adjacent central incisor* (white dotted line), *but a lack of soft tissue thickness persists.*

the treated tooth with the adjacent incisors for 5 to 6 months.

Oral Hygiene During and After Orthodontic Therapy

Throughout the active orthodontic phase, patients were recalled for site-specific debridement and polishing of the exposed root at 2-week intervals during the first month and then at 1-month intervals until active orthodontic therapy was completed; all the while, patients continued with local chlorhexidine applications twice a day. Afterwards, during the retention phase, patients were recalled every 2 months and used chlorhexidine once daily. All patients underwent a full-mouth scaling and prophylaxis session every 4 to 6 months.

Surgical Procedure

After completion of the retention phase, all patients underwent mucogingival surgery for resolution of the recession defect. The implemented surgical technique was the vertically-coronally advanced flap (V-CAF) + connective tissue graft (CTG),[19,20] which consisted of a trapezoidal flap for single recession defects with two horizontal incisions located in interproximal keratinized tissue (KT), and two slightly divergent vertical incisions extended into the alveolar mucosa. Flap elevation was performed with a split-full-split thickness approach: split-thickness at the level of the papilla and vertical incisions; full-thickness in the midbuccal portion (unless the absolute absence of KT forced the use of an intrasulcular incision); and split-thickness again, first deep (parallel to the periosteum) and then superficial (parallel to the alveolar mucosa) in order to dissect muscles from the underlying periosteum and from the alveolar mucosa of the flap, respectively.

Fig 3 (a) *Buccal and* (b) *profile views after elevation of the split-full-split thickness flap.* (c) *Intraoperative measurement of the bone dehiscence depth was 5 mm.* (d) *Placement of a 5-mm–tall connective tissue graft at the level the cementoenamel junction. A tight adaptation of the graft can be seen on the* (e) *profile and* (f) *occlusal views.* (g) *Buccal,* (h) *profile, and* (i) *occlusal views after suturing the vertically-coronally advanced flap, which completely covers the connective tissue graft in a passive manner.*

Once a tension-free flap was obtained, the 4- to 5-mm–high apical strip of labial submucosal tissue previously attached to the periosteum was removed. Root surfaces were prepared mechanically with manual instrumentation and chemically with ethylenediaminetetraacetic acid application (24% for 2 minutes). Interproximal soft tissues (anatomical papillae) were deepithelialized with the surgical blade and microsurgical scissors. A CTG, obtained by extraoral deepithelialization of a free gingival graft harvested from the palate, was placed at the tooth's CEJ and stabilized to the base of the deepithelialized anatomical papillae with simple interrupted sutures (7-0 polyglycolic acid [PGA]). The CTG dimensions were as follows: The mesiodistal length was 1 mm less than the distance between the two vertical incisions; the apicocoronal height was 4 to 5 mm, irrespective of the root dehiscence depth; and graft thickness was < 1 mm. Flap closure was achieved with a coronal sling suture (6-0 PGA) at the level of the papillae, as well as simple interrupted sutures, with periosteum anchorage, along the vertical incisions (7-0 PGA). At the end of the surgery, the flap completely covered the CTG (Fig 3).

Postsurgical Plaque Control

Patients were instructed to interrupt mechanical cleaning of the treated area and rinse with a chlorhexidine solution (0.12%) 3 times a day for 2 weeks, until suture removal.

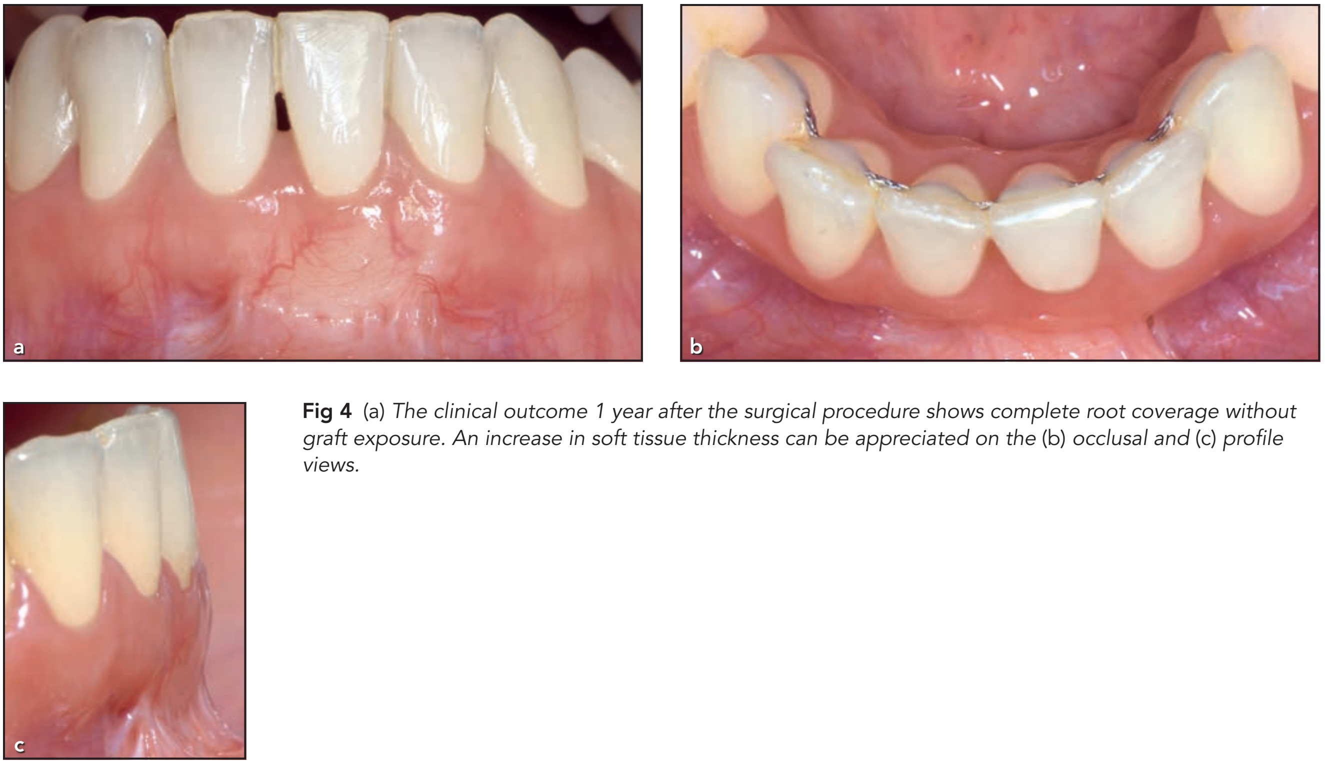

Fig 4 (a) *The clinical outcome 1 year after the surgical procedure shows complete root coverage without graft exposure. An increase in soft tissue thickness can be appreciated on the* (b) *occlusal and* (c) *profile views.*

Plaque control was maintained with chlorhexidine rinses for 2 more weeks. After this period, patients mechanically cleaned the treated area using a soft toothbrush and a roll brushing technique. Prophylaxis recalls were at 1, 3, and 5 weeks after suture removal and, subsequently, once every 3 months until the final 1-year examination (Fig 4).

Data Analysis

Statistical analysis was performed with SPSS version 24.0 (IBM). Descriptive statistics were computed for measurements at T0, T1, and T2. The GR-D, GR-W, PD, CAL, KTH, and GT parameters were expressed as mean ± SD. A 95% confidence level was considered (P = .05). Variables reporting categorical outcomes were expressed by frequency distributions. When data followed a normal distribution, paired Student t test was used to evaluate differences between T0–T1, T1–T2, and T0–T2. Percentage of RC was calculated as: ([recession at T0 – recession at T2] / recession at T0) × 100. CRC was also computed.

Results

A total of 20 patients were selected and treated with the proposed novel orthodontic-mucogingival approach. Postoperative healing was uneventful: No bleeding or significant discomfort/pain was reported. Mean values of the clinical parameters observed in the study and their changes between T0 and T1 and T2 are reported in Table 1. At T0, all recessions were Miller Class III or IV defects, with a pronounced recession depth (6.13 ± 1.41 mm) and width (4.05 ± 0.6 mm), as well as negligible KTH (0.3 ± 0.47 mm). At T1, all recessions had become Miller Class I or II defects, with statistically significant improvements in both mean GR-D and GR-W (recession reductions of 1.8 ± 0.95 mm and 1.8 ± 0.7 mm, respectively); CAL measurements experienced a significant reduction (ΔT0–T1 = 3.3 mm), and there was a slight increase in KTH (1.2 ± 0.43 mm). Also at T1, the intrasurgical mean BD-D amounted to 4.8 ± 1.01 mm, and mean BD-W was 3.1 ± 0.45 mm. At T2, CRC was obtained in 18 of the 20 subjects (90%), with a mean RC of 98.04% ± 6.29%. This

Table 1 Clinical Variables Throughout the Study Period

	T0 (n = 20)	T1 (n = 20)	T2 (n = 20)	ΔT0–T1	ΔT1–T2	ΔT0–T2
GR-D	6.13 ± 1.41	3.94 ± 0.97	0.1 ± 0.31	–1.8 ± 0.95*	–3.8 ± 0.95*	–5.6 ±1.5*
GR-W	4.05 ± 0.6	2.25 ± 0.55	0.25 ± 0.79	–1.8 ± 0.7*	–2.0 ± 0.86*	–2.0 ± 0.86*
PD	2.8 ± 0.52	1.22 ± 0.43	1.44 ± 0.53	–1.5 ± 0.61*	–0.1 ± 0.72	–1.4 ± 0.68*
CAL	8.5 ± 1.64	5.2 ± 1.06	1.5 ± 0.61	–3.3 ± 1.17*	–3.7 ± 1.26*	–7 ± 1.78*
KTH	0.3 ± 0.47	1.2 ± 0.43	1.86 ± 0.69	0.9 ± 0.55*	0.5 ± 0.51*	1.4 ± 0.6*
GT	0.38 ± 0.09	0.74 ± 0.15	1.62 ± 0.23	0.37 ± 0.13	0.88 ± 0.24*	1.24 ± 0.24*

T0 = baseline; T1 = end of retention phase, after orthodontic therapy; T2 = 1 year after surgical therapy; GR-D = gingival recession depth; GR-W = gingival recession width; PD = probing depth; CAL = clinical attachment level; KTH = keratinized tissue height; GT = gingival thickness.
*Statistically significant difference.

translated into a final vertical recession reduction of 5.6 ± 1.5 mm and a CAL gain of 7 mm. As a result of the combined approach, gingival tissues experienced a > 1 mm increase in both KTH and GT. The final RES score at T2 was 9 ± 1.3, with only 2 out of the 20 sites reporting graft exposure (10%). The mean patient-reported esthetic satisfaction VAS score was 9.7 ± 0.7 (range: 8 to 10).

Discussion

This novel orthodontic-surgical approach was highly successful in the treatment of deep Miller Class III and IV GRs affecting buccally malpositioned mandibular incisors. The mean RC was 98.04%, and CRC was achieved in 90% of treated cases.

To date, few publications have addressed specific options to treat similar cases[9,11,21–24] by orthodontically replacing the tooth within the bony housing; they all reported a significant periodontal improvement after orthodontic treatment alone. The main clinical advantage of the new orthodontic device introduced in the present study resides in its ability to selectively move the target tooth in a controlled manner while involving a small number of teeth: The bonded arch was placed up to the first premolars, and the lingual orthodontic tube and Warren spring on the target tooth acted in synergy to modify its root torque without creating undesired extrusion or proclination. As a result, presurgical treatment time was reduced and the rest of the dentition remained unaltered, as opposed to conventional orthodontic therapy. Furthermore, conventional orthodontics require expertise and specific orthodontic training; tooth movement by means of the FZ Root Torque Controller is not operator-dependent and can be executed even by dental professionals who are not specialized in the field of orthodontics.

The present findings corroborated that the baseline gingival variables (Table 1) improve immediately after orthodontic therapy as a direct result of repositioning the tooth inside of the alveolar bone housing. In addition, analysis of the clinical parameters supports the hypothesis of spontaneous buccal bone regeneration, as can be appreciated by comparing the baseline CAL (8.5 ± 1.64 mm) and the intraoperative bone dehiscence depth (4.8 ± 1.01 mm). If one considers that the buccal bone level at baseline was located apical to the CAL, a mean bone regeneration value of nearly 5 mm can be extrapolated. A similar improvement seems to have occurred with the horizontal component of the dehiscence defect, as the intrasurgical value of the BD-W (3.1 ± 0.45 mm) was lower than the baseline GR-W (4.05 ± 0.6 mm). Therefore, it can be inferred that the initial BD-W was greater than the baseline GR-W, which leads to the conclusion that the BD-W also decreased by the time of the intrasurgical measurement. The nearly 2-mm reduction in mean GR-D after presurgical orthodontic therapy, accompanied by a CAL gain of > 3 mm, proves that the supracrestal tissue attachment was also spontaneously reestablished in a more coronal position.

Predictability of RC for single and multiple GRs in the mandibular incisors has been confirmed by several studies.[19,20,25,26] However, what remains imperative is that tooth malposition negatively affects the chances for achieving CRC.[14] By turning Class III and IV GRs into Class I and II GRs, the suggested approach not only made recession coverage procedures more predictable (90% CRC), but it also created better soft tissue conditions for their execution, as evidenced by the reduction in PD values and increase in KTH at T1, which are signs of improved health and stability of the gingival tissues. This increase in KTH (ΔT0–T1: 0.9 ± 0.55 mm) was of crucial importance from a clinical and surgical point of view, as the presence of even a minimal amount of KT is critical for stability of the surgical flap in the final coronal position and for reducing the risk of flap shrinkage.

Some of the previously cited studies performed only orthodontic correction of the mandibular incisor position,[23,24] not addressing the latent risk for further recession progression even in a correctly positioned tooth. In the present study, surgical correction of the mucogingival defect was considered fundamental for the improvement of the gingival phenotype (GT ΔT0–T2: 1.24 ± 0.24 mm) to prevent recession progression or recurrence, as indicated in the literature.[8] Given the nature of the employed surgical technique, the CTG was completely covered by the CAF, and increasing KTH was not one of the procedure goals; therefore, this value remained almost unvaried after surgery (KTH ΔT1–T2: 0.5 ± 0.51 mm). This can be considered a positive outcome from an esthetic point of view, due to the risk of color mismatch and difference in surface characteristics that result from graft exposure. The high RES values and high patient-reported satisfaction VAS scores achieved can be attributed to the high percentage of CRC and the very low percentage of cases with graft exposure. Additionally, a spontaneous increase in KTH can be expected in the long term due to the realignment of the mucogingival junction.[27]

Conclusions

The treatment sequence of this orthodontic-mucogingival approach allowed for selective correction of root malposition at the target tooth, an estimated spontaneous gain of buccal bone in the dehiscence area, and improved presurgical soft-tissue conditions, which translated into excellent postoperative results in terms of CRC, increased GT, and improved esthetic outcomes. Being a pilot case series, limitations such as lack of a control group and control for operator/investigator bias are present. Further research should be conducted to demonstrate the efficacy of the proposed treatment and to confirm the validity of the results at a larger scale.

Acknowledgments

The authors declare no conflicts of interest.

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