SEQUENCING of Periodontal Procedures and Orthodontic Treatment

For Long-Term Esthetic Outcome: A 5-Year Case Report

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Abstract

Severe cases of periodontal disease often require periodontal surgery and realignment of teeth. Surgical techniques have been developed that attempt to minimize postsurgical gingival recession and compromise the interdental papillae. A case report is presented in which reversal and correction of a deteriorating maxillary frontal dentition were effectively achieved through combined use of periodontal and orthodontic principles. The treatment plan included the control of periodontal inflammation, restoration of lost attachment apparatus, realignment of anterior dentition, stabilization of occlusion, and minor periodontal plastic surgery. The anticipated loss of a maxillary lateral incisor was avoided. Restoration of a pleasant smile with nicely aligned teeth and esthetic gingival contours was achieved. The correct sequencing of the procedures involved was considered a key factor for the long-term esthetic outcome.

Key Words: sequencing, esthetics, bone, mucogingival, regeneration, orthodontics, periodontal

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Introduction

Advanced periodontal disease is primarily characterized by severe attachment loss and reduction of alveolar bony support. The condition usually presents as tooth mobility, migration, spacing, and marginal gingival recession. In the maxillary anterior region, the functional damage is usually accompanied by compromised esthetics. Patients with advanced periodontal disease often require periodontal surgery that frequently results in additional gingival recession and esthetic deterioration. Since the 1960s, several surgical techniques have been developed to minimize postsurgical gingival recession and preserve the interdental papillae.[1-7] These techniques are specified by the effort to prevent unnecessary excision of healthy gingival tissue, prevent reduction of bony tissue, and locate the flaps as far coronally as possible by advanced flap procedures and suturing techniques.

Orthodontic realignment of migrated, severely periodontally involved teeth is usually initiated after surgical control of inflammation.[8] The timing of this treatment after periodontal surgery is still controversial. A long healing period and radiographic evidence of bone apposition before initiating orthodontic tooth movement has been advocated.[9] Others claim that better results are achieved when orthodontic movement starts shortly after completion of periodontal regenerative therapy.[10-14]

This article describes a case that utilized the "regeneration-then-early-orthodontics" approach, which was applied to restore function and esthetics in a maxillary anterior dentition severely compromised by periodontal disease. The fulfillment of esthetic requirements by periodontal plastic surgery, carried out only after realignment of the anterior dentition, is also demonstrated.

Figure 1: Preoperative smile demonstrates tooth migration with developing interdental spaces and gingival recessions at the maxillary lateral incisors.

Case Presentation

A 48-year-old female presented complaining of migrating maxillary incisors, appearance of interdental spaces, and overall unpleasant presentation of her smile **(Fig 1)**. Based upon previous dental consultation, the patient anticipated replacement of the right lateral incisor with an implant restoration. She wished to restore function and esthetics of the maxillary anterior dentition. Her medical condition was normal and non-contributory. Clinical examination revealed tooth mobility, migration, and spacing in the maxillary incisor area, particularly the right lateral incisor that had drifted both horizontally and vertically. Generally, probing pocket depths ranged from 3 to 5 mm. However, the right lateral incisor presented with a 7-mm pocket, coupled with moderate loss of papilla height on the mesial aspect and labial gingival marginal recession. Additionally, the left lateral incisor presented with a minor (yet esthetically disturbing) labial recession, and a 6-mm pocket depth on its labio-distal aspect. The marginal tissue was neither overtly inflamed nor bleeding. Radiographic examination revealed generalized moderate bone loss with severe vertical bony defect on the mesial aspect of the maxillary right lateral incisor **(Figs 2a & 2b)**.

The patient was diagnosed with generalized moderate-to-advanced periodontitis, accompanied by secondary occlusal trauma. The prognosis was good, except for the maxillary right lateral incisor, which was considered unsecured. After discussing treatment options, the patient agreed to undergo periodontal and orthodontic therapies in an effort to restore function and esthetics without removing the lateral incisor. The objectives were to control periodontal inflammation, restore lost attachment apparatus, realign the anterior dentition, harmonize marginal gingiva contours, and stabilize the occlusion. However, contrary to the authors' suggestion, the patient declined periodontal surgery as the first choice to control inflammation and regenerate lost tissues.

Figures 2a & 2b: Preoperative radiographic images reveal deep vertical bony defect mesially on the left lateral incisor.

Figure 3: Fixed edgewise brackets with Cu-Ni-Ti wire to level and align the maxillary incisors.

Clinical Procedure

Non-Surgical Therapy

At the patient's request an attempt was made to control inflammation non-surgically; this included five consecutive sessions of scaling and root-planing.

After three months, periodontal examination revealed significant improvement in pocket depths.

Orthodontic Therapy (Initial Phase)

A standard edgewise stainless steel fixed appliance was bonded to the entire maxillary arch. Minimal forces to level and align the maxillary incisors were used via a super-elastic thin wire (made of copper, nickel, and titanium). Special effort was made to improve the vertical, horizontal, and long axis positions of the maxillary right lateral incisor **(Figs 3 & 4)**. Six months after initiation of orthodontic therapy teeth alignment improved, but no significant enhancement of gingival contours around the right lateral incisor was achieved **(Fig 5)**. At this point, the patient agreed to return to our first strategy (i.e., implementation of periodontal regenerative surgery prior to orthodontic treatment).

Periodontal Regenerative Surgery

Since the brackets and wire were already mounted, it was decided that they remain attached and non-active. This would help stabilize the teeth that required surgery. The papilla preservation technique was implemented. Sulcular incisions were made around the right canine, the right lateral incisor, and the right and left central incisors; vertical releasing incisions on the right canine and left central incisors enabled full

Figure 4: Deep defect mesially on the lateral incisor at initiation of orthodontic treatment.

Figure 5: Six months after initiation of orthodontic treatment, improved teeth alignment was noted, but recessed gingiva around the right lateral incisor was evident.

Figure 6: Deep, partially contained bony defect was noted mesially and buccally on the right lateral incisor. Note that unnecessary detachment of the central buccal papilla was avoided.

Figure 7: Palatal flap design with preservation of interdental soft tissue; both mesial and distal papillae of the lateral incisor remained part of the buccal flap.

thickness flap elevation both buccally and lingually, fully exposing the deep defect on the right lateral incisor **(Figs 6 & 7)**.

The defect was degranulated and the roots planed and treated with enamel matrix derivatives **(Fig 8)**. The defect was filled slightly coronal to its contained part, with deproteinized bovine bone particles **(Fig 9)**. Flaps were closely adapted to the root surfaces and sutured by first intention, using 6-0 polyamide sutures to ensure complete coverage and isolation of the bone grafted defect **(Figs 10 & 11)**. The orthodontic wire was immediately connected, as the mobility of the lateral incisor was expected to increase and interfere with the healing process.

Postoperative Instructions and Follow-up

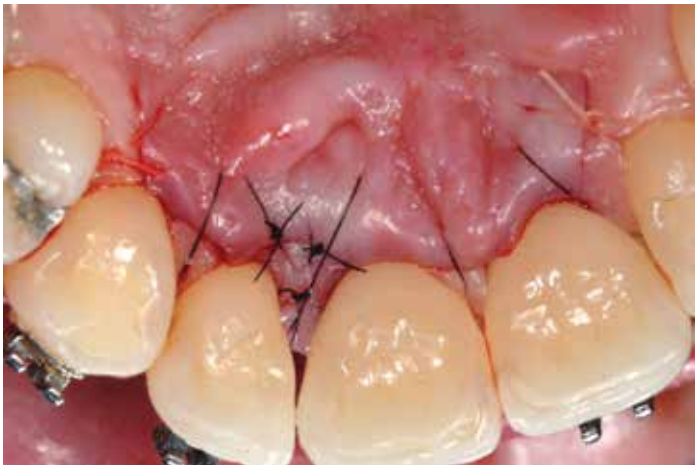
An analgesic (naproxen sodium 275 mg, Teva; Petah-Tikva, Israel), was prescribed for three days, four times daily. The patient was instructed to abstain from brushing and flossing around the surgical area until suture removal (14 days), and to consume only soft food during the first week. She was also instructed to avoid any other trauma to the treated area. After two weeks, the patient was instructed to floss and use the coronally directed roll technique with a Clinic Gum Protector extra-soft toothbrush (Jordan; Oslo, Norway). After four weeks, she changed to a stronger (yet still soft) toothbrush (Elmex, GABA; Switzerland) using the Bass brushing technique. During the first four weeks, the patient used a 0.2% chlorhexidine solution rinse (Tarodent, Taro; Haifa, Israel) for one minute twice daily. She was also recalled for professional supragingival biofilm control: weekly for the first four weeks, then monthly for the first six months.

Orthodontic Therapy (Definitive Phase)

Five weeks after surgery, complete wound closure was evident with maximal protection of the grafted bony defect. Partial root coverage of the right lateral incisor was noted; however,

Figure 8: Following defect degranulation and root-planing the root was treated with enamel matrix derivatives.

Figure 9: Deproteinized bovine bone particles were grafted in the contained and non-contained parts of the bony defect.



Figures 10 & 11: 6-0 polyamide simple sutures were used to approximate the buccal and palatal flap by primary intention.

the associated interdental mesial papilla level remained unchanged **(Fig 12)**. The aim was to advance the interdental papilla coronally. Since no space existed between the right lateral and right central incisors, reactivation of orthodontic treatment at this phase was targeted mainly at root approximation rather than at the crowns of these teeth. This was achieved by using stainless steel light wires and minimal orthodontic forces. Additionally, some minor interproximal reductions were made, mesially and distally to the maxillary right incisors, to create a stable and more apically located contact area **(Fig 13)**. During orthodontic treatment, the patient's motivation was maintained by visiting the dental hygienist on a monthly basis. The fixed appliance was debonded after seven months, and the teeth were splinted with a braided stainless steel wire, bonded with a composite resin **(Fig 14)**. The referring restorative dentist bonded a composite resin to the mesio-incisal edge of the mesially tilted right central incisor.

At completion of active treatment, clinical examination showed a well-functioning, natural-looking anterior dentition. Minor gingival recession at the left lateral incisor was still noted **(Fig 15)**. Radiographic examination revealed favorable root/crown ratios (although minor apical root resorption of the right lateral incisor was evident), dense crestal osseous profiles, and appreciable bone fill in the grafted intrabony defect **(Fig 16)**.

Figure 12: Initiation of second phase of orthodontic treatment (five weeks after surgery). Light stainless steel wires were activated to approximate between roots of the right lateral and central incisors.

Figure 13: Seven months post-initiation of orthodontic treatment (second phase), improved papillae and marginal tissue position were achieved; however, mesial inclination of the right incisor was noted.

Figure 14: At completion of orthodontic treatment, the front anterior sextant was splinted with a braided stainless steel wire, bonded with a composite resin.

Figure 15: At completion of active treatment, a composite resin was bonded to the mesio-incisal edge of the inclined right incisor. Significant tooth alignment and improved gingival contours were achieved, but minor root recession of the left lateral incisor was still present.

Figure 16: At completion of orthodontic treatment, dense osseous crestal profiles with appreciable bone fill were present. However, minor periapical resorption of the right lateral root was noted.

Periodontal Plastic Surgery

Six months after orthodontic therapy, a root-coverage procedure at the left lateral incisor could be implemented. It was decided to limit the surgical field to the involved tooth to avoid potential damage to the almost ideal gingival contours achieved on the neighboring teeth. Because crestal bone distally of the tooth was partially missing, with some loss of papilla height (Miller Class III)[15] **(Figs 17 & 18)**, a bilaminar surgical approach was implemented.[16] Vertical oblique incisions were made at the mesial and distal line angles of the crown, extending up to a distance of approximately 3 mm apical to the mucogingival junction line. New surgical papillae were elevated by splitting the anatomical papillae, followed by full thickness flap elevation up to the mucogingival line, revealing the full extent of the exposed root and the neighboring alveolar bone **(Fig 19)**. Horizontal splitting incisions were made to free the flap completely from muscle attachments and the underlying periosteum and to allow coronal flap advancement without tension.

The root was planed and smoothed with periodontal curettes and rotatory finishing diamond burs up to the level of premeasured soft tissue attachment. A thin and mostly dense connective tissue graft was harvested from the palate and placed to cover the exposed root surface **(Fig 20)**. After de-epithelialization of the adjacent papillae, the flap was coronally advanced and secured at a level slightly coronal to the cemento-enamel junction (along with the underlying connective tissue graft) using 7-0 polyvinylidene fluoride (Serag-Weissner; Naila, Germany) simple sutures at the vertical line incisions. A 6-0 polyamide (Ethilon, Ethicon; Somerville, NJ) sling suture around the tooth achieved further graft anchorage. No periodontal dressing was used **(Fig 21)**.

Figure 17: Left lateral incisor shows a Miller Class III gingival recession.

Figure 18: Minimal crestal bone resorption was present between the left lateral incisor and the canine.

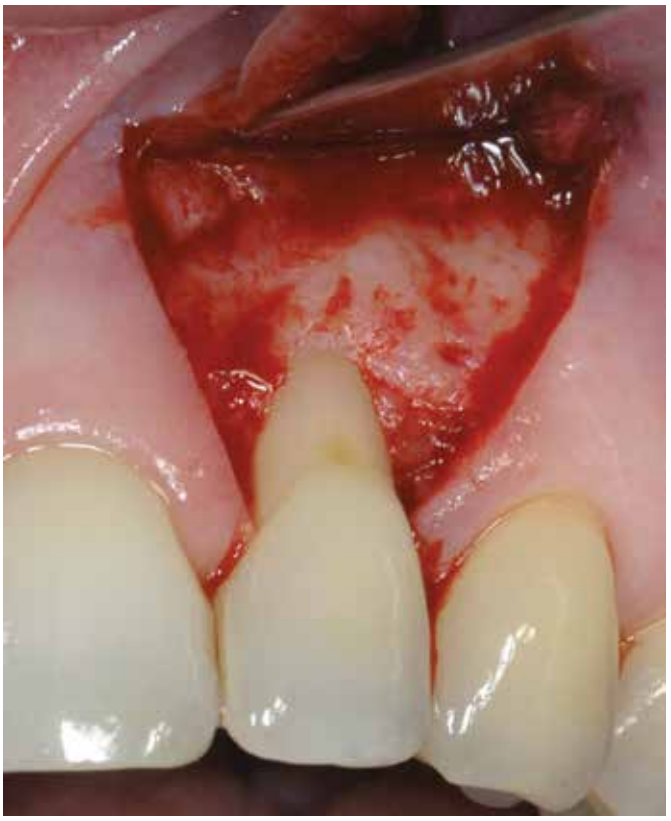


Figure 19: A triangular-shaped split-full-split flap was elevated and the root surface planed.

Figure 20: A thin dense connective tissue graft was placed to cover the exposed root and 2 to 3 mm around the bone.

Figure 21: A combination of 6-0 polyamide and 7-0 polyvinylidene fluoride sutures was used to fix both the grafted tissue and the coronally advanced flap.

"The esthetic appearance of the maxillary anterior dentition is determined to a considerable degree by the contour, size, and health of the labial gingiva and the interdental papillae."

Figure 22: Two weeks after the root-coverage procedure, healing was uneventful. The patient was instructed to use the coronally directed roll technique for harmless brushing and effective plaque control.

Figure 23: At case completion, the right lateral incisor was properly intruded, and the marginal gingiva and interdental papillae regained normal appearance.

Figure 24: At completion of treatment, the patient presented with a nice smile, showing well-aligned teeth with healthy and nicely contoured gingiva.

Postoperative Instructions and Follow-up

Instructions similar to those after the regenerative surgery were given **(Fig 22)**. However at two months the patient was instructed to return to the coronally directed roll technique using a stronger (still soft) toothbrush (Elmex, Gaba; Switzerland). To complement biofilm control the patient was instructed to use a single tufted brush (Paro 1003, Esro; Kilchberg, Switzerland) splayed and used to sweep along the gingival line of the maxillary incisors.

At the end of treatment, the patient presented with a nice smile and reasonable tooth alignment, together with well-defined interdental papillae and no recessed marginal tissue **(Figs 23 & 24)**. Radiographic examination revealed solid crestal profiles, with considerable bone fill at the right lateral incisor **(Fig 25)**. A four-year follow-up revealed a successfully maintained long-term esthetic result **(Fig 26)**. At the five-year postoperative follow-up the upper right central received a new Class IV composite restoration that improved the patient's smile **(Figs 27 & 28)**.

Figure 25: The radiographic view revealed solid crestal bone profiles with bone fill at the right lateral incisor.

Figure 26: At the four-year follow-up, the successful results had been well maintained.

Figure 27: Five-year follow-up image, frontal view. The Class IV restoration of the maxillary right central had been renovated; however, slight gingival recession on the tooth was noted.

Figure 28: Five-year follow-up image. The patient exhibited a pleasing smile with maintained tooth alignment and esthetic gingival contours.

Discussion

The esthetic appearance of the maxillary anterior dentition is determined to a considerable degree by the contour, size, and health of the labial gingiva and the interdental papillae. The normal contour, shape, and consistency of the gingival tissues may change dramatically with the occurrence and perpetuation of periodontal inflammation, especially when coupled with tooth migration. In this complex case, the patient's treatment was based upon the following rationale:

A. Periodontal regenerative procedure is the preferred choice in patients with deep defects.

A non-surgical approach may be encouraged for the maxillary anterior dentition.[17] However, in patients with very deep pockets, proper defect debridement with efficient root and gingival curettage may be achieved only by surgical therapy.[17-19] The deep bony defect of the maxillary right lateral incisor was localized primarily on the mesio-buccal aspect. Therefore, a rather extensive labial flap was elevated. This significantly improved visibility and access to the surgical area for meticulous curettage of the diseased root and bony defect, and for a controlled and adequate implementation of the bone grafting process.

Treatment of intrabony periodontal defects with a combination of an enamel matrix derivative and natural deproteinized bovine bone material has been shown to significantly improve clinical parameters such as probing depth, clinical attachment level, and fill of the osseous defect.[20-24] Although guided tissue regeneration is a well-documented and beneficial regenerative surgical modality, it was excluded to avoid possible complex flap manipulations and risk of membrane infection.[25-27]

Soft tissue preservation and use of mattress sutures in the interdental papillary area ensured optimal isolation and protection of the regeneration site with minimal postsurgical gingival and interdental papillae recession. This was further ensured by slight releasing of the flap from the underlying periosteum and muscle attachments.

B. Orthodontic treatment performed only after periodontal regeneration enhances attachment gain and improves tissue contours.

To optimize the esthetic appearance of the periodontally inflamed and spaced maxillary anterior dentition, attention should be given to the use of advanced periodontal surgical methods and to the proper integration of the necessary orthodontic treatment. Tooth movement with active periodontal disease can accelerate attachment loss.[8,28,29] However, some clinicians still advocate initiation of tooth movement before periodontal surgery is carried out. They claim that tooth movement decreases volume of bone defect and increases the collective area of bony walls, thereby increasing the regeneration potential.[30,31] Yet, most clinicians to date advocate initiation of orthodontic treatment only after periodontal regeneration has been completed. This approach is based on previous clinical observations and research, as follows:

1. In deep pockets, non-surgical therapy will be inefficient in defect debridement and root decontamination.[18,32,33] This may deepen and widen the bony defect, especially during tooth movement.[8,28,29]
2. Closed interdental spaces result in narrow papillae that are difficult to manipulate during surgery and may become ineffective in maintaining full coverage of the implanted graft materials and the clot, thus compromising the healing process.[7,34]

3. A wide defect allows for improved surgical access for effective debridement and root-planing, and for decortications of surrounding bony walls to recruit bone-forming cells to the wound.
4. Crown and/or root approximation may push the interproximal and marginal tissues coronally and more effectively if implemented only after completion of regenerative therapy. This may result in creeping of marginal gingiva and gain in interdental papillae height.[9,10]

C. Orthodontic therapy should start early following periodontal regeneration.

Only limited data exist regarding optimal timing of tooth movement following bone grafting procedures. Some clinicians claim that early initiation of tooth movement (two to four weeks after the regenerative procedure) is advantageous due to reduced resistance to orthodontic forces, thereby shortening the orthodontic and overall treatment period.[10-14] However, others believe that tooth movement in early wounds may potentially stimulate osteoclastic activity, which will result in root resorption.[9] At this time, no short-term clinical or radiographic evidence exists to contradict the initiation of orthodontic treatment six weeks after the regenerative procedure as was carried out in the presented case. Regardless, care was taken to use only light orthodontic forces to minimize micro movements of the organizing blood clot and optimize the biologic conditions for periodontal regeneration.

D. Orthodontic intrusion of recessed teeth may help resolve bony defects and gingival coronal creeping.

Tooth intrusion following periodontal surgical therapy may enhance clinical attachment, providing biomechanical force system and oral hygiene are maintained.[35-37] This phenomenon is not completely understood, although two possible mechanisms have been suggested:

• The stretching of the periodontal ligament fibers at the marginal level generates a "natural filter," reducing the down-growth of epithelium.

• Orthodontic stimulation increases the turnover in the periodontal ligament, thereby improving the chances of periodontal ligament cells to repopulate the previously infected root surface.[35]

E. Root-coverage procedure performed only after teeth alignment is more predictable.

In the past, it has been argued that teeth with recessed or thin gingiva would indicate mucogingival grafting to precede orthodontic tooth alignment. It was believed that tooth movement inside, and even more outside, the alveolar bone envelope would cause further injury to the already stretched and vulnerable marginal tissues. Therefore, early root coverage was considered a preventive measure.[38,39] However, recently clinicians claim that root coverage prior to tooth movement is unnecessary for several reasons:

1. Controlled tooth movement would "bring" the bone with the tooth, and no further recession would likely occur. Thus, no change in prediction of maximum root coverage would follow.[15]
2. Gingival grafting would not guarantee resistance of grafted marginal tissue to mechanical or bacterial provocation that can occur during tooth movement. Therefore, the patient may be exposed to a second "round" of gingival grafting.[40,41]
3. In most cases, orthodontic treatment moves the roots back into the envelope of alveolar bone. This in itself may reduce marginal recession, and definitely provide better conditions for successful root coverage.[42,43]

F. The bilaminar approach using the triangular coronally advanced flap is preferred for isolated Class III recession defects.

In most cases with interdental crest and papilla loss, complete root coverage is unpredictable.[15,44] However, to maximize coverage, it is necessary to increase the width of a naturally thin gingiva by harvesting a connective tissue graft composed of dense connective tissue.[16,44-46] The use of the triangular-shaped advanced flap may contribute to effective nourishment of the grafted tissue, allow for easy and effective flap advancement with full protection of the graft, and decrease the probability of tissue scarring. Complete root coverage with gingiva of thick biotype, though non-predictable in Class III recessions, may still be achieved.[44]

Summary

Advanced periodontal and orthodontic treatment may result in the restoration of function to the periodontally involved dentition and in marked improvement in esthetics. The case presented demonstrates a gain in clinical attachment, radiographic evidence of bone fill, significant coronal creeping of the marginal gingiva, and almost complete reformation of the interdental papilla between the right maxillary central and lateral incisors. Therefore, it may be assumed that root approximation together with retraction and intrusion of the incisors collectively resulted in "excess" soft tissue, labially and interdentally, being pushed and stretched in a coronal direction. This may be predictably achieved when orthodontic movement begins early after periodontal regenerative treatment. However, the correction of gingival contours via root-coverage procedure may be more successful if implemented only after tooth alignment. This correct sequencing of clinical procedures in multidisciplinary treatment of a periodontally and esthetically compromised dentition is a key factor in achieving long-lasting functional and esthetic results.

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"This correct sequencing of clinical procedures in multidisciplinary treatment of a periodontally and esthetically compromised dentition is a key factor in achieving long-lasting functional and esthetic results."

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