A New Flapless Technique for Crown Lengthening After Orthodontic Extrusion

Orthodontic extrusion (OE), which is performed in many different clinical situations to move a tooth or its periodontal tissues coronally, is often associated with supracrestal fiberotomy and root planing (OEFRP) or followed by surgical crown lengthening. The OEFRP procedure must be carried out every 2 weeks during the entire extrusive orthodontic phase, and precise control of the technique itself can be quite difficult, especially when this approach is to be performed on a limited portion of the root perimeter in teeth affected by angular defects. The aim of this study was to show a new nonsurgical crown-lengthening technique, performed shortly after the completion of OE, to simultaneously achieve proper hard and soft tissue architecture. Three different illustrative situations (periodontal pocket, root fracture, and root perforation) are described. (Int J Periodontics Restorative Dent 2012;32:81–90.)

Orthodontic extrusion (OE) has been proposed in many different clinical situations where a tooth or its periodontal tissues need to be moved coronally. Heithersay¹ recommended OE for the treatment of horizontal fractures in the middle third of the root. Simon et al² suggested dental extrusion of endodontically compromised teeth. Ingber³,⁴ described forced eruption for the treatment of infrabony pockets to decrease the bony defect and reported the need for surgical crown lengthening after the retention phase to restore the appropriate biologic width for the following prosthetic restoration.

Pontoriero et al,⁵ when considering that the tension of the periodontal fibers brought about by the extrusive orthodontic movement produces the coronal migration of periodontal tissues, suggested associating OE with supracrestal fiberotomy (SCF). However, even following SCF performed weekly with intrasulcular incisions through the junctional epithelium and connective tissue during the period of forced eruption, a correction of the
gingival tissue outline, although minor, was often necessary after the completion of extrusion.\textsuperscript{5}

However, Levine and Stahl\textsuperscript{6} showed that after SCF, the gingival fiber apparatus reforms for the most part because of reattachment of the fibers remaining in the root surface. To avoid this, Kozlovsky et al\textsuperscript{7} proposed to couple coronal planing with SCF associated with OE every 2 weeks. This technique was effective in preventing the coronal migration of bone and gingival tissues.

Carvalho et al\textsuperscript{8}, in a randomized clinical trial on teeth without periodontal pockets comparing the OE technique to the OE technique associated with fiberotomy and root planing (OEFRP), confirmed that the OEFRP technique was effective in preventing coronal migration of the gingival margin. However, the OEFRP technique does not always seem convenient, since the fiberotomy and root planing procedures are required every 2 weeks during the entire OE phase, and precise control of the technique itself is quite difficult, especially when this approach is to be performed on a limited portion of the root perimeter in teeth affected by angular defects, where OE is intended to decrease a bony defect.

The aim of this study was to show a new nonsurgical crown-lengthening technique, performed shortly after the completion of OE, to achieve proper bone architecture to obtain the best compliance in a patient-centered treatment approach when a surgical approach is to be avoided for different causes, such as anxiety or economic reasons.

Method and materials

Three different clinical situations involving the periodontium (periodontal pocket, root fracture, and endodontic perforation) were treated according to the procedure described below. All three patients displayed the following features: excellent general health, no intake of any medication, no use of tobacco, and no aggressive periodontitis status.

Before the beginning of OE, the teeth were prepared to obtain knife-edged finish lines and provided with provisional crowns. After having determined the clinical attachment level of the adjacent teeth through careful periodontal probing, enough OE was planned so that the deepest part of the lesions (ie, bottom of the periodontal pocket, fracture line, caries lesion, etc) would be carried 1 to 1.5 mm more coronal than the corresponding clinical attachment level of the adjacent teeth, allowing for remodeling procedures. Then, OE (1.5 to 2 mm every month) was performed with light and continuous forces supplied by either cantilevers, as part of segmented mechanics, or with the double-wire technique, using a stainless steel sectional archwire as anchorage on the adjacent teeth and a nickel-titanium sectional archwire in overlay as the active component of the appliance. At the same time, the tooth was progressively reduced to avoid occlusal trauma.

Approximately 2 to 3 weeks after the completion of OE, the provisional restorations were removed, and the nonsurgical crown-lengthening procedure was performed. With the aid of a 5\texttimes magnifying binocular system and a fiber-optic light device, intrasulcular tooth preparation was carefully performed by continuously probing the level of the tissues surrounding the tooth.\textsuperscript{9} During tooth preparation with D3 burs (Intensiv) mounted on turbine handpieces, the connective fibers extruded in excess were removed from the root surface of the abutment, achieving the same level of clinical attachment as the adjacent teeth. In this way, a flapless crown-lengthening procedure was performed, providing a normally scalloped gingival contour and adequate ferrule effect for the future prosthetic crown. The provisional restorations were relined with resin (or remade when necessary), carefully polished, coated with glazing resin to minimize dental plaque buildup, and then luted with temporary cement. Their margins were intentionally kept 1 to 1.5 mm below the gingival margin to allow for reshaping of the gingival contour, avoiding reattachment of the connective fibers to the root surface.

Chlorhexidine rinses (0.1%) were prescribed twice a day for 4 weeks, according to the protocol usually adopted after periodontal surgical procedures.\textsuperscript{10} For post-orthodontic retention, the extruded
teeth were splinted to the adjacent elements for at least 5 months before the final restoration was performed. Meanwhile, the provisional crowns were removed monthly and their margins and profiles reshaped, if necessary, following the desired contraction of the gingival contour. Even periodic supportive therapy was carried out monthly with prophylaxis; instrumentation with curettes was performed only if necessary.

**Patient 1**

A 42-year-old woman presented with the chief complaint of unacceptable esthetics resulting from unsatisfactory prosthetic restorations (Fig 1a). In addition, some of her posterior teeth were missing, and she felt that some type of restoration was required. The patient requested to avoid any surgical procedure to solve her problems. Thorough examination revealed prosthetic restorations both in the anterior and posterior areas. The maxillary anterior teeth showed deep periodontal probing depth (PPD) values (Table 1), while periapical radiographs displayed diffuse bone height loss and large posts in the roots of the maxillary incisors. Several posterior teeth were missing, and a prosthetic fixed partial denture (FPD) in the second quadrant showed an improper occlusal plane. A deep bite was present, and the overall picture strongly suggested a loss of vertical dimension, consistent with the lack of several posterior teeth.

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PPD = periodontal probing depth; OE = orthodontic extrusion.
*Bold numbers denote pathologic values.
†FDI tooth-numbering system.
The patient underwent initial periodontal therapy and, after 1 month following its completion, a reevaluation was performed and the new PPDs assessed. By this time, the maxillary incisors still showed deep PPDs (Table 1), and some serious doubt surrounded their prognosis since the increased PPDs could be the result of root fractures correlated with the large posts seated in their roots. As a result, the final plan of action was intentionally postponed. The patient was informed and accepted such a course of action. The treatment plan was as follows: The posterior loss of vertical dimension was to be corrected with both the uprighting of the posterior inclined teeth and the provisional FPD in the second quadrant. Since the patient was not willing to accept any type of surgery, implant therapy included, the missing posterior

Fig 1a  Patient 1. Pretreatment intraoral photograph of existing prosthetic restorations.

Fig 1b  New provisional crowns were applied before initiating OE of the maxillary incisors. The bite appears less deep than in the pretreatment photograph, since the initial posterior loss of vertical dimension was corrected with both orthodontic treatment and provisional FPDs in the posterior regions.

Fig 1c  Completion of OE. Approximately 4 mm of extrusion was obtained in 3 months using segmented arch mechanics releasing continuous light forces. The crown height appears decreased as a result of the occlusal reduction performed to avoid trauma during OE. The changed position of the supporting tissues, which were more coronal, is an effect of OE.

Fig 1d  Definitive crown restorations. Gingival recessions at the maxillary canines were not treated, owing to the patient’s refusal to undergo surgical procedures.
teeth were to be replaced with traditional prosthetic FPDs. Reevaluation of the maxillary incisors for the final treatment plan was scheduled after the completion of the orthodontic phase in the posterior areas.

After the completion of orthodontic treatment, the posterior occlusal planes appeared leveled and the bite less deep. The maxillary incisors still displayed deep PPD values, and their prognosis still appeared uncertain. Therefore, it was decided to orthodontically extrude them to help the correction of their high PPD values or, as a mandatory alternative, to develop the implant site(s) if the maxillary incisor(s) could not be saved. This strategy was fully explained and accepted by the patient. Previous crowns were removed, and new provisional crowns applied (Fig 1b). Then, the maxillary incisors were orthodontically extruded. Light continuous forces released by segmented arch mechanics produced approximately 4 mm of extrusion in 3 months (Fig 1c). Then, the periodontal condition of the extruded incisors was reevaluated to create the final treatment plan. Since a decrease in the PPD values (Table 1) was found and a lack of inflammatory signs seemed to be stabilized, it was established that all maxillary incisors could be maintained.

Since the patient refused any type of surgical procedure, a nonsurgical approach was performed to obtain the necessary crown lengthening. The maxillary incisors were re-prepared “drawing” the correct bone architecture, according to the previously described technique, and new provisional crowns were applied. After 5 months, final impressions were taken and the definitive restorations were luted (Fig 1d, Table 1). Gingival recessions at the maxillary canines were not treated since the patient refused to undergo any type of surgical procedure.

Patient 2

A 43-year-old woman complained about the fracturing of her maxillary left first premolar, which had received endodontic treatment some years before and now displayed a fracture extending up to 2 mm beneath the free gingival margin (Fig 2a). To maintain the tooth while at the same time achieve a correctly scalloped gingival margin, the following treatment plan was scheduled: endodontic re-treatment, provisional restoration, OE, crown lengthening, and definitive crown restoration. Under local anesthesia, retraction cord was placed in the gingival sulcus of the maxillary left first premolar, displacing the connective fibers. The tooth was rebuilt with composite resins and covered with a provisional crown. After root canal re-treatment, the tooth was orthodontically extruded approximately 4 mm in 2 months using light continuous force with the double-wire sectional fixed appliance technique. Three weeks after the completion of OE (Fig 2b), the nonsurgical crown-lengthening procedure was performed.
The provisional crown was relined and luted with temporary cement, according to the described technique. After 5 months (Fig 2c), the impression for the definitive restoration was taken, and the treatment was then completed (Fig 2d).

**Fig 2a**  Patient 2 presented with a fracture extending up to 2 mm beneath the free gingival margin in a maxillary first premolar that had received endodontic treatment some years before. After the tooth was rebuilt with composite resins, endodontically re-treated, and covered with a provisional crown, approximately 4 mm of OE followed by crown lengthening was scheduled to obtain a correctly scalloped gingival margin at a proper level.

**Fig 2b**  Three weeks after the completion of OE, typical redness of the gingival margin (the “red patch”\(^{13}\)) was still present. Extrusion needed to be performed in excess, foreseeing the necessary amount of the future crown lengthening, to allow the placement of a prosthetic crown with an adequate ferrule effect while at the same time providing a normally scalloped gingival contour.

**Fig 2c**  Five months after flapless crown lengthening, the impression for the definitive restoration could be taken.

**Fig 2d**  Definitive crown restoration.

**Patient 3**

A 36-year-old woman came to the dental office seeking care for a toothache at the maxillary left first premolar, which displayed an improper filling placed within its root canal and revealed a perforation of the root wall (Fig 3a). Endodontic treatment preceded by a
provisional composite buildup was performed immediately. After 3 months, the case was reevaluated to complete the treatment with the needed definitive restoration. Since the root perforation was located 4 mm under the crestal bone, it seemed necessary to reestablish the proper biologic width before proceeding to the final prosthetic restoration. Therefore, OE followed by flapless crown lengthening was performed to reestablish the proper biologic width before proceeding to the final prosthetic restoration and to keep the correctly scalloped gingival margin at the proper level.

Fig 3a  Patient 3. Endodontic perforation of the root wall of the first premolar was noted bringing on an acute inflammatory process. Since the root perforation was located approximately 4 mm beneath the crestal bone, OE followed by flapless crown lengthening was scheduled after the application of a composite buildup and endodontic re-treatment to reestablish the proper biologic width before proceeding to the final prosthetic restoration.

Fig 3b  The first premolar was extruded approximately 5 mm in 2 months using a double-wire sectional fixed appliance releasing light continuous forces. OE was performed in excess to allow for flapless crown lengthening.

Fig 3c  Two weeks after the end of the OE active phase, the tooth was ready for the crown-lengthening procedure according to the flapless technique.

Fig 3d  Definitive crown restoration.
Discussion

In many different clinical situations, an orthodontic approach is frequently needed to improve the prognosis of the affected teeth. Moderate or shallow periodontal pockets (4 to 5 mm), deep subgingival caries lesions, endodontic resorptions, and fractures can benefit from OE treatment to allow for further restorative therapies. Although a side effect of this technique is supraocclusion of the extruded teeth, thus requiring their shortening and often leading to endodontic treatment and prosthetic restoration, this approach can be advantageous in many cases, such as in reducing discrepancies in alveolar bone crest levels.

Namely, so-called “forced eruption” has been described for the treatment of infrabony pockets, where it is possible to obtain coronal positioning of intact connective tissue attachment with the extrusive movement, thereby decreasing the bony defect and obtaining shallower sulci in teeth with advanced periodontal disease. An experimental study in periodontally healthy monkeys revealed that following OE, there was no attachment loss, and the changes in the position of the probed sulci bottoms moved the same distance as the tooth extrusion while the margin of the free gingiva did not shift, resulting in a decrease in sulcus depth of approximately 20% of the extrusion in the short term.

However, it is not always desirable to have the periodontium follow the tooth in its extrusive movement since, in many cases, it may be convenient to move a tooth out of its periodontal support. In teeth with crown-root fractures at the subgingival level, the goal of treatment may be to force the tooth to erupt out of the periodontium to perform a proper prosthetic rehabilitation. In such cases, the extrusive movement should be combined with gingival fiberotomy and root planing. The excision of the coronal portion of the fiber attachment around the tooth should be performed once every 2 weeks so that the tooth can be moved out of the bone without affecting the bony and gingival levels of the neighboring teeth. However, this excisional procedure is often not well accepted by patients and requires cooperation in the dental office. Moreover, it may not always be reliable, especially when angular bone defects are present or, generally speaking, when the bone crest surrounding the affected tooth does not have a normally scalloped architecture. In this situation, effective use of the surgical blade in the depth of the pocket could prove to be difficult, and a fixed orthodontic appliance could be an additional obstacle for precise fulfillment of the correct procedure. Besides, when angular defects are present, it might be convenient that only a portion of the periodontium follows the tooth during extrusion while the remaining portion may not need to be carried coronally. For these reasons, before a proper definitive restoration can be fabri-
cated, further surgical treatment, ie, surgical crown lengthening, is often mandatory after the orthodontic movement is completed to obtain normally scalloped hard and soft tissues and to expose the required amount of sound dental tissue. Surgery, however, is not always well accepted by patients for many different reasons. In esthetically critical regions such as the maxillary incisor or premolar area, the clinician can often be pushed into challenging procedures to obtain satisfying results, which often require complete mastery of the surgical technique.

When prosthetic restoration of the extruded tooth with a full crown is needed, an alternative option can be considered. After the core is built up and the tooth is prepared and provided with a provisional crown, OE can take place. The tooth must be prepared with a knife-edged finish line at the level of the alveolar crest, following the profile of the connective attachment. After the necessary amount of dentin has been removed to eliminate the undercuts, the distance between the connective attachment and the deepest portion of the lesion can be assessed more accurately. The boundary of the connective attachment can be appreciated using careful probing with the aid of magnifying glasses and a fiber-optic light. In this way, the anatomy of the affected tooth and its surrounding tissues can be evaluated to plan the amount of extrusion required. This procedure allows more precision than that achievable with only preoperative periodontal probing. Comparing the level of attached connective tissue of the adjacent teeth, the amount of extrusion required to eventually obtain a proper architecture of the hard and soft periodontal tissues can be determined and planned with the orthodontist, anticipating approximately 1 to 1.5 mm of overextrusion to allow for the remodeling procedure.

OE can be performed quite rapidly, even 3 to 4 mm per month depending on the amount of periodontal support. Since the appliances can be removed soon after the end of active treatment, oral hygiene becomes easy once again in a relatively short time, which is especially advantageous for periodontal patients. Approximately 2 to 3 weeks after the completion of forced eruption, the necessary tissue remodeling of the just-extruded periodontal tissues is performed before their complete mineralization to eventually achieve normally scalloped crestal levels. According to the previously described technique, the procedure is carried out with a bur. While the tooth is reprepared with the knife-edged finish line, the fibers inserted on the root are removed, similarly to osseous resective surgery, leaving a positive tissue architecture at the end of the surgical procedure. Then, the provisional crown, relined and maintained in place splinted to adjacent teeth for postorthodontic retention, conditions the soft tissues. The crown has to be polished precisely to avoid plaque buildup on the crown surface; the use of glazing varnish can be useful.

It is worth mentioning that the subgingival preparation performed before and after orthodontic treatment should not be underestimated, since it is a quite tricky procedure requiring a skilled operator with thorough knowledge of anatomy and great attention to every single detail.

When the amount of extrusion required is considerable, as in heavily periodontally compromised teeth, extrusion tends to produce interproximal wide spaces because of the conical shape of the root, creating a discrepancy that may be necessary to modify with the definitive crown. To avoid or reduce black holes in the gingival contour, which are hardly acceptable for patients after surgery, especially in anterior areas, some papilla preservation techniques are usually employed if a traditional surgical approach is chosen. As an alternative for such cases, the described flapless technique can be helpful in overcoming some adverse implications of traditional surgical techniques and, hence, decreasing the risk of esthetic failure, provided all the operative details are performed carefully.
References