Rapid Extrusion With Fiberotomy

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Rapid extrusion with fiberotomy as an alternative to traditional crown lengthening modalities is described. Given appropriate anatomic conditions, rapid extrusion with fiberotomy may be utilized as a viable and esthetic crown lengthening procedure.

The treatment of an isolated tooth in which the clinical crown has been destroyed due to trauma, caries, or iatrogenic dentistry often results in a complicated and/or compromising situation.

Clinical objectives such as esthetics, periodontal health, and placement of margins on sound tooth structure have been traditionally managed by (1) extraction of the isolated tooth and subsequent fixed prosthesis, (2) exposure of sound tooth structure by periodontal surgery, or (3) forced eruption in conjunction with periodontal surgery.

Of these traditional treatment modalities, forced eruption with periodontal surgery is most successful in achieving our clinical objectives. Unfortunately this procedure, as well as the other traditional approaches, often involves healthy adjacent teeth either by surgical exposure or restorative dentistry.

PRINCIPLES ASSOCIATED WITH TRADITIONAL FORCED ERUPTION THERAPY

Forced eruption therapy for the treatment of isolated nonrestorable teeth as described by Ingber is based on the biologic premise that orthodontically erupted root segments are accompanied coronally by their associated gingiva and supporting structures.[1] Reitan and others have demonstrated histologically and clinically that eruptive tooth movements result in a stretching of the gingival and periodontal fibers, which produces a coronal shift of gingiva and bone.[2–6]

During forced eruption, elongating forces result in an increased and continuous tension on the principle periodontal fibers causing the deposition of bone on the walls of the alveolar bone with little resorptive activity other than to realign and maintain trabeculae, and replace bundle bone and continued remodeling of periodontal ligament.[5] Apparently tensile forces transmitted via intact principal fibers and periodontal ligament possess the potential to stimulate bone remodeling.

Yeh and Rodan have demonstrated in vitro that tensile forces exerted on a subpopulation of osteoblasts resulted in increased prostaglandin synthesis (PGE_2).[7] Somjen et al also demonstrated in vitro that physical forces resulted in PGE_2 synthesis, and that this was concurrent with increased cyclic AMP production and DNA synthesis. It is hypothesized that physical forces stimulate bone remodeling through a stimulus receptor system mediated by prostaglandin.[8] Therefore, it is reasonable to conclude that intact principal fibers and periodontal ligament are responsible for the coronal migration of alveolar bone during forced eruption therapy. Consequently, osseous correction becomes necessary in order to achieve enough sound tooth structure to place a restoration and provide for periodontal health. Rosenberg and others have outlined biologic considerations regarding tooth lengthening procedures. In order to place a subgingival restoration, a minimum of 4 mm sound tooth structure should be exposed above the crest of alveolar bone to provide for adequate tooth structure, junctional epithelium, and connective tissue.[9]

PRINCIPLES ASSOCIATED WITH RAPID EXTRUSION WITH FIBEROTOMY

The same principles that apply to traditional forced eruption therapy also apply to the rapid extrusion with fiberotomy technique. Potashnick and Rosenberg have outlined anatomic considerations and rationale for

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forced tooth eruption. In a previous publication, they emphasize clinical aspects of treatment that must be contemplated prior to therapy. Esthetics, clinical root length, root proximity, root morphology, furcation location, individual tooth position, collective tooth position, and the ability to restore the teeth all must be considered.[10]

Rapid Extrusion With Fiberotomy

Rapid extrusion with fiberotomy (RE/F) requires additional clinical and biologic consideration. A desirable crestal bone/attachment apparatus relationship to the adjacent teeth must be present prior to RE/F because, following therapy, this relationship remains as it was before eruption.

In essence the root simply "pulls" out of the bone without altering the osseous architecture. To do so, healthy attachment apparatus is invariably sacrificed equal to the amount of sound tooth structure gained clinically.

Severing the connective tissue attachment (via fiberotomy) apparently eliminates the transmission of tensile forces to the periodontium and prevents osseous remodeling at a level coronal to the remaining intact fiber attachment.[11] Pontoriero et al have demonstrated clinically that where principal fibers were severed during forced eruption therapy, bone did not accompany the tooth in a coronal direction, and where fiberotomy wasn't performed, bone did remodel coronally after a 3 to 6 month period of time.[12] However, even with fiberotomy the coronal shift of the gingiva was not predictably stable.[13–16] To assure an esthetic gingival margin position following rapid extrusion with fiberotomy therapy, a gingival correction procedure may be necessary.

After proper dentogingival relationships have been cultivated, the new tooth position should be stabilized to allow osseous remodeling.[1,3] After 6 to 8 weeks stabilization, a provisional restoration is placed to assure satisfactory esthetics and functional stability prior to permanent restoration.

Case Report

The patient is a 55-year-old black female who presented to the graduate Periodontal Clinic at the University of Pennsylvania for treatment. Examination revealed a fractured maxillary left central incisor with a nonfunctional post-core-crown restoration placed a year ago (Figs. 1A and B). Caries extended into the root preparation, and as a result of the previous crown preparation, the gingival margin was positioned apical relative to the adjacent teeth (Fig. 1A; see also Fig. 13A). The patient was referred for a tooth lengthening procedure to provide sufficient tooth structure with proper dentogingival relationships for placement of an esthetically healthy and functional single crown restoration.

Figure 1*A*. Fractured maxillary left central incisor. Note the apical position of the gingival margin and caries extending into the root preparation.

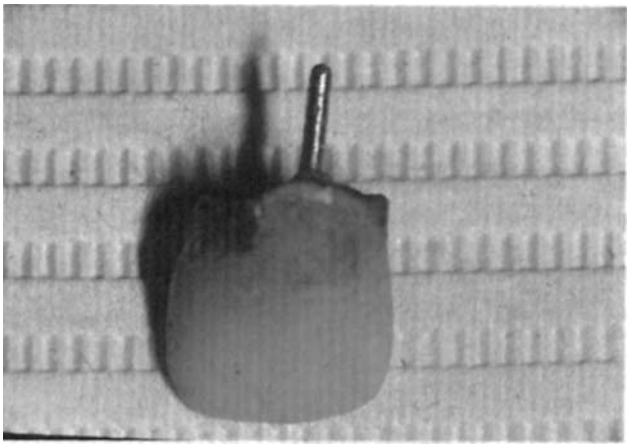

Figure 1*B*. Non-functional post-core-crown restoration. Patient presented with the crown in hand. Caries and debris within the root preparation prevented replacement on to the tooth.

Initial therapy included complete documentation, oral hygiene instruction and plaque control procedures. Radiographic evaluation and periodontal probing revealed a horizontal crestal bone relationship with 1 to 3 mm probing depths (Fig. 2A). Given the anatomic situation, in order to achieve our clinical objectives, RE/F was the elected treatment modality of choice.

Following caries removal, a serated post (Vlock 63L7/Brasseler, Savannah, GA 31419) was permanently cemented into the root preparation with zinc phosphate cement. This particular design was chosen because the post was to be utilized for both the eruptive procedure and to retain a core build-up as part of the final restoration (Fig. 3A; see also Figs. 9A and B).

It is important to anticipate where the post will terminate relative to the alveolar crest and realize following eruptive therapy that the post must terminate within the alveolar bone to avoid possible root fracture.

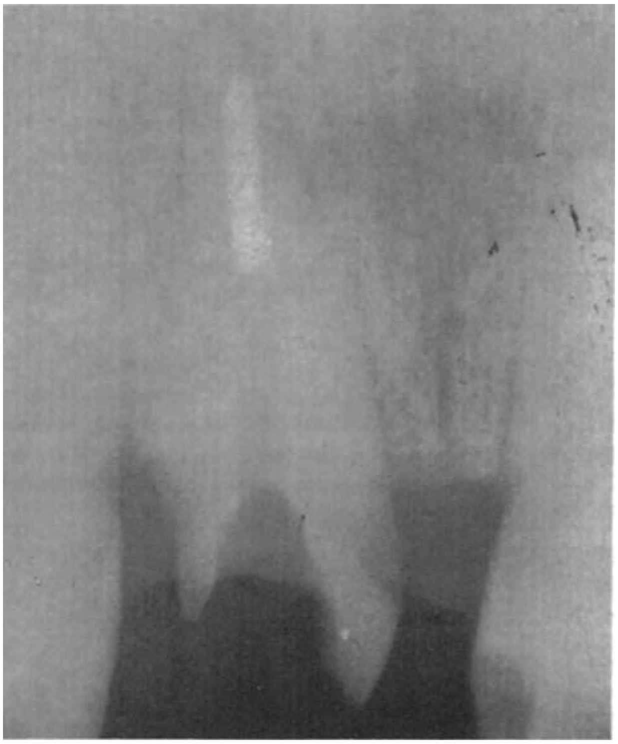

Figure 2. Radiograph taken at initial presentation for crown lengthening procedure. Note the horizontal osseous crest relationship to the adjacent teeth.

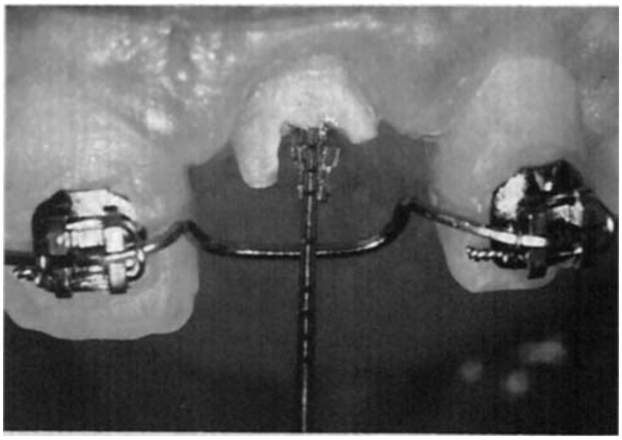

Figure 3A. Orthodontic appliance passively in place. Note there is approximately 2 mm distance between the serated post and the passive 0.022 × 0.025 stainless steel rectangular wire.

Figure 3B. Occlusal view of passive orthodontic appliance; note the off-set bend positioning the wire directly over the post to extrude the root axially into proper position.

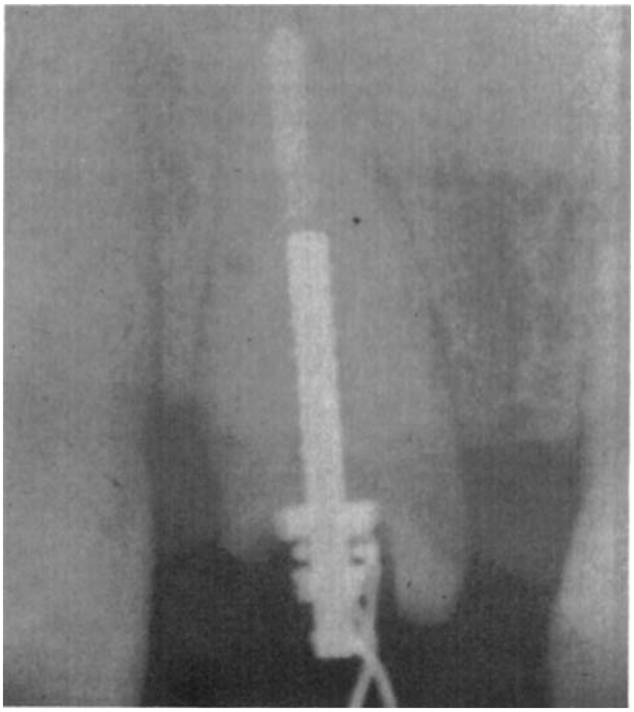

Figure 4A. Radiograph demonstrating post placement 6 mm within alveolar bone prior to eruption.

In this particular case, 3 mm of eruption was anticipated, therefore the post placement is at least 6 mm within the alveolar bone prior to eruption (Fig. 4A).

Orthodontic brackets were placed canine to canine and a rectangular 0.022 × 0.025 stainless steel wire was fabricated and actively tied to the serated post (Fig. 3A). As the wire rebounds an extrusive force is exerted axially over the post and erupts the root into proper position (Fig. 3B; see also Fig. 6B). It is important to check the opposing occlusion and avoid any interferences with the eruptive process.

The patient was anesthetized by infiltration of local anesthesia prior to sulcular fiberotomy. Circumferential sulcular fiberotomy was performed with a Barde Parker #15 scalpel and Kirkland gingivectomy knife. The blades were carefully positioned within the sulcus down to alveolar bone and within the periodontal ligament space. Principal fibers coronal to alveolar bone were severed the entire circumference of the tooth until no

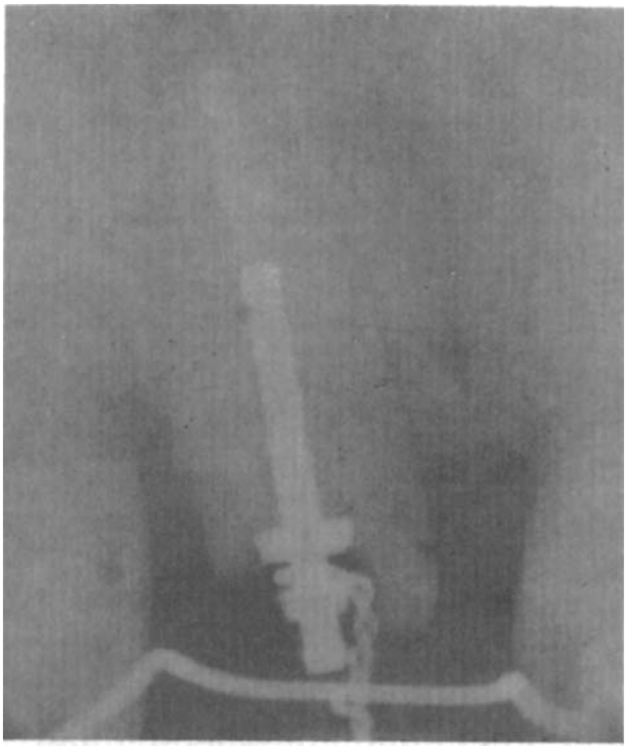

Figure 4*B*. Radiograph taken with active orthodontic appliance day 1.

intact fibers remained anchored to the root surface (Fig. 5B).

To assure that all connective tissue fibers were destroyed, the root was subsequently scaled with a curette. The fiberotomy procedure was repeated once a week during the eruptive process and again at stabilization.

The root was erupted approximately 1 mm per week for 3 weeks (Figs. 6A,B, and 7A,B). At week 3, a

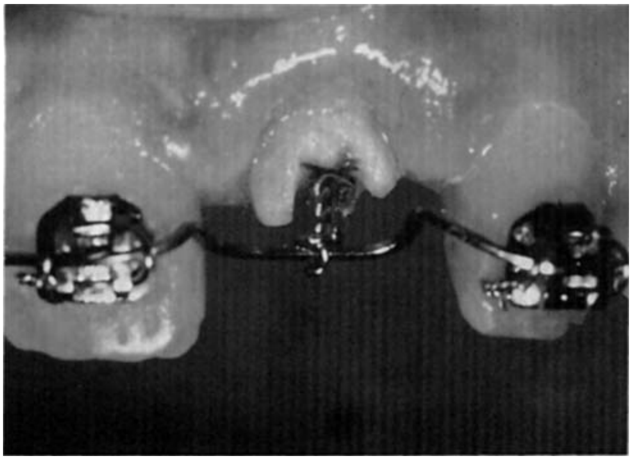

Figure 5*A*. Orthodontic appliance actively in position, day 1. The rectangular wire has been tied down with a ligature wire and now contacts the serated post. In this position, there is tension in the wire exerting an extrusive force over the post.

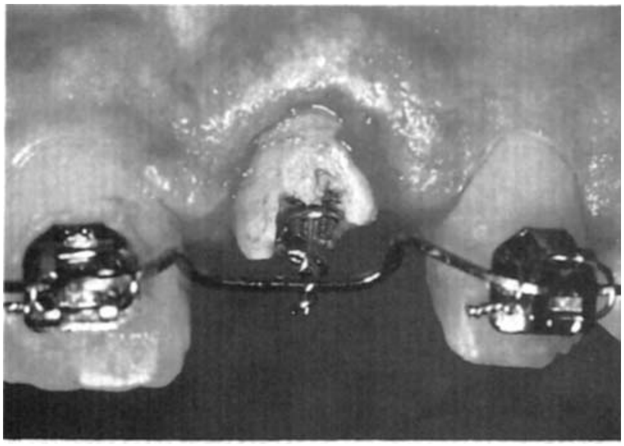

Figure 5*B*. Orthodontic appliance actively in position day 1 after circumferential sulcular fiberotomy.

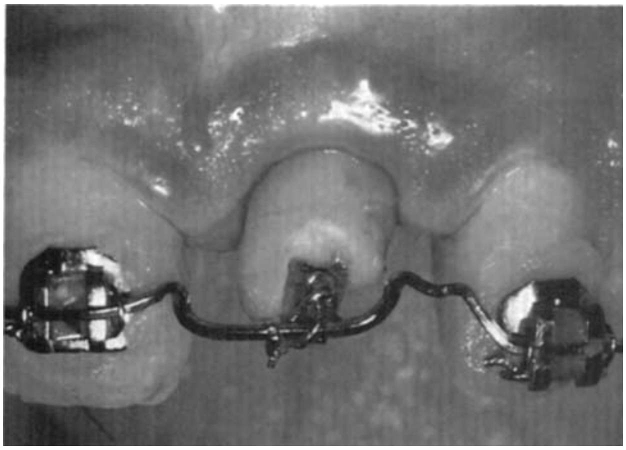

Figure 6*A*. Week 2 evaluation after 3rd fiberotomy.

final fiberotomy was performed and the tooth was stabilized for 8 weeks with a rectangular wire bracketed to a P-30 core build-up (Fig. 8A). The tooth is out of

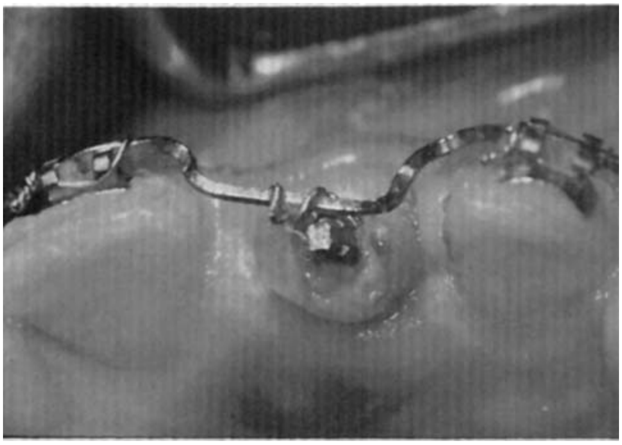

Figure 6*B*. Week 2 evaluation occlusal view. Note the axial relationship buccal-lingually.

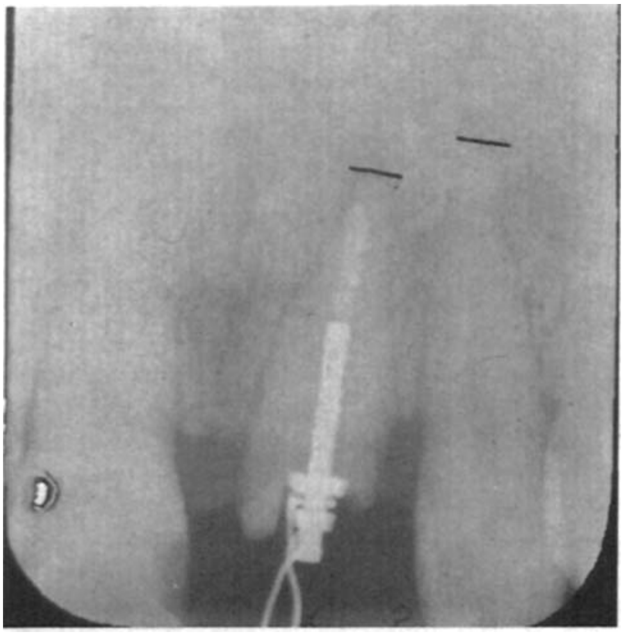

Figure 7*A*. Radiograph day 1 prior to eruption, note the relationship between the root apices and of the post to crestal bone.

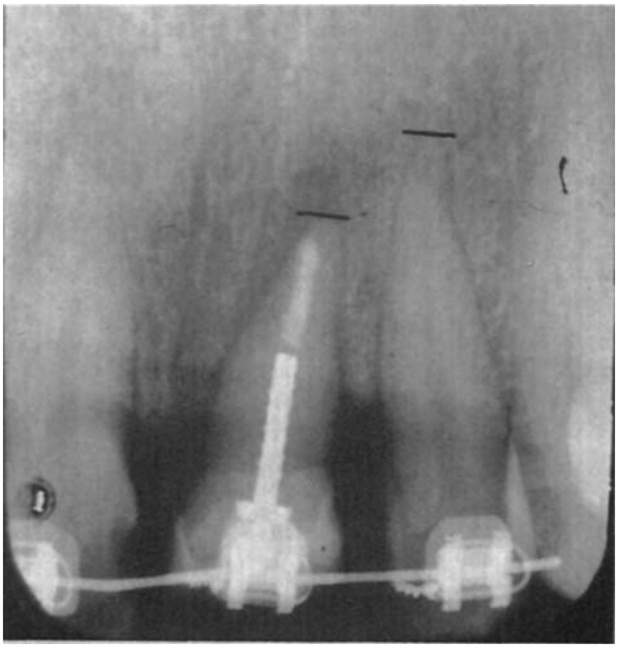

Figure 7*B*. Radiograph week 3 at stabilization. The distance between the root apices have increased and the post termination remains in alveolar bone. Note the radiolucency at the apex and wide PDL space. Comparing with Figure 7A, one can approximate the amount of eruption.

occlusion to prevent any intrusive pressure and allow osseous remodeling at the apex (Fig. 8B).

A provisional restoration is placed 3 months following forced eruption therapy (Figs. 9A,B; 10A,B; and 11A,B). It is important at this time to evaluate the position of the gingival margin and its relationship to the adjacent teeth. In this particular case, the gingival relationship is at an acceptable level to provide an

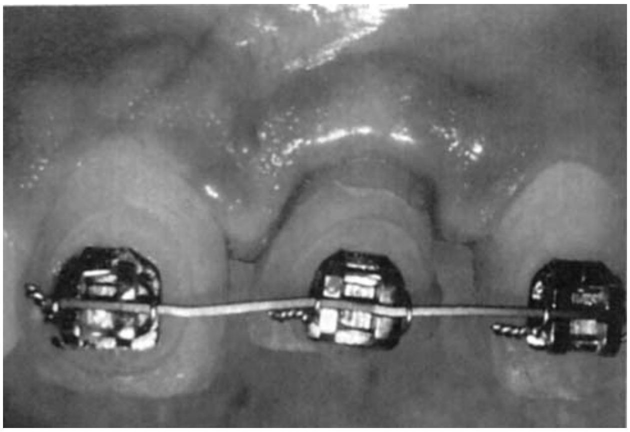

Figure 8*A*. Week 3 stabilization with rectangular wire bracketed to a P-30 core build-up following final fiberotomy.

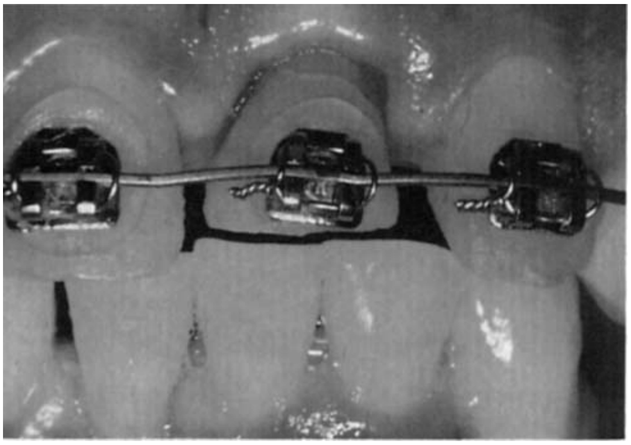

Figure 8*B*. Week 3 stabilization. Note the tooth is left out of occlusion.

Figure 9*A*. Crown preparation 6 months post stabilization.

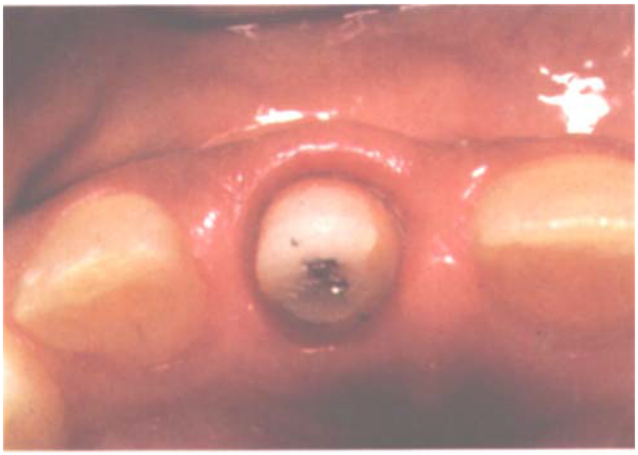

Figure 9*B*. Crown preparation occlusal view. Note the axial relationship and sulcular morphology.

Figure 10*A*. Provisional restoration 6 months post stabilization.

Figure 10*B*. Provisional restoration occlusal view 6 months post stabilization.

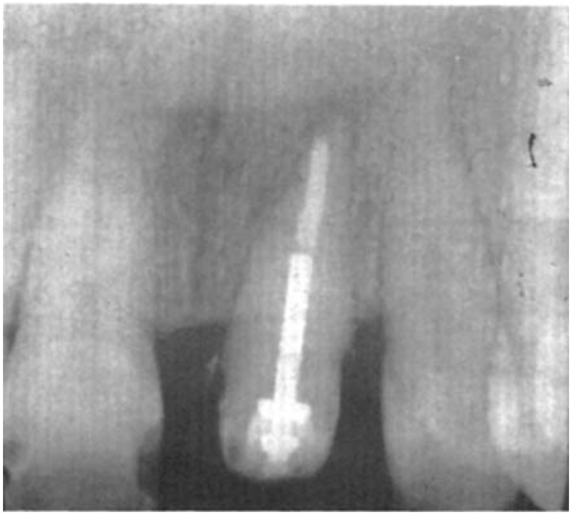

Figure 11*A*. Radiograph 6 months post stabilization. Note the osseous remodeling apically and at the osseous crest.

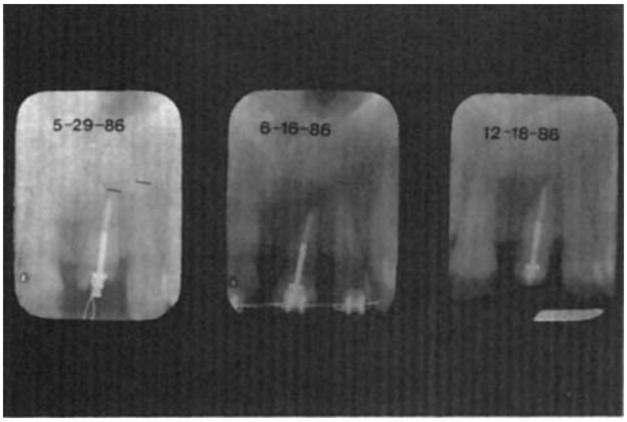

Figure 11*B*. Composite radiographs illustrating the forced eruption with circumferential fiberotomy sequence. Shown left to right are day 1 prior to eruption, week 3 stabilization, and 6 month post stabilization.

Figure 12*A*. Final restoration.

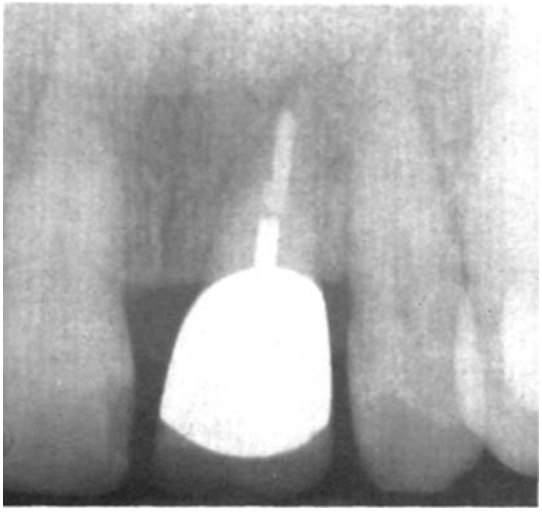

Figure 12*B*. Radiograph final restoration.

Figure 13*A*. Initial presentation.

esthetic result. If it were necessary, a corrective gingival procedure would be undertaken at this time. The occlusion was carefully adjusted to ensure a stable position and adequate function. After the clinical objectives have been managed with the provisional restoration, a final restoration is placed (Figs. 12A,B, and 13B).

CONCLUSION

Given the appropriate anatomic conditions, rapid extrusion with fiberotomy may be utilized as a viable crown lengthening procedure. Principles associated with RE/F therapy are described and a case report illustrates RE/F technique.

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Figure 13*B*. One year after therapy.

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