Forced Eruption of a Solitary Nonrestorable Tooth Using Mini-Implants as Anchorage: Rationale and Technique

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Purpose: The need to place a restoration's margins on sound tooth material may require crown lengthening or forced eruption. The latter intervention may benefit from a severance of the tooth's circumferential fibers during the orthodontic process in an effort to stabilize the bone level. Orthodontic appliance design for the extrusive action, especially in the absence of neighboring teeth, may require the use of mini-implants, which are a useful adjunct in such situations. ***Materials and Methods:*** This case history describes the management of a maxillary left canine that lacked sound tooth material in the cervical zone for a proper ferrule. It was diagnosed as requiring extrusion so as to recruit it into an abutment role for a fixed partial denture design. This treatment modality was considered more favorable compared to the alternative of a crown lengthening procedure. The tooth in question was a strategic abutment in an old and failing porcelain-fused-to-metal fixed prosthesis. ***Results:*** Fiberotomy permitted rapid extrusion of the canine and available sound tooth margins for crown preparation with a proper ferrule. ***Conclusion:*** Following 28 days of tooth stabilization the implants were easily removed and treatment continued as originally planned. *Int J Prosthodont 2009;22:441–446.*

A subgingivally placed post and core creates a clinical problem for future crown placement since controlled abutment preparation with a desired ferrule encroaches on the tooth's attachment tissues.[1–17] The fracture resistance of endodontic and post and core–treated teeth demands a ferrule design of at least 2 mm for long-term stability. A subgingival fracture or decay does not allow a ferrule design of 2 mm without violating valuable supporting structures.[18–20] This may be resolved by a crown lengthening procedure, which risks sacrificing the alveolar bone of neighboring teeth.[21]

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The alternative of a forced eruptive effort raises the defect level of the root from within the alveolar bone to a position above its crest.[22] This objective demands a greater extrusion rate than the one associated with extrusion used for periodontal reasons (bony defect elimination or gingival alignment) or the unpredictable and usually slow rate of extrusion for unopposed teeth. Consequently, combining rapid extrusion with a fiberotomy can help to maintain the desired tooth movement without its attachment apparatus.[23–29] The validity of combining a fiberotomy and root planing during extrusion for achieving crown lengthening without altering the position of the gingival margins was confirmed in a randomized clinical trial study.[30]

Performing this procedure in the case of a solitary tooth without adjacent neighboring teeth is a challenge, especially when the target tooth is a pier abutment (part of a long-span provisional fixed restoration).

One option is to use a removable orthodontic appliance, which needs the patient's acceptance and is obviously less convenient.[31] Another option is using magnets placed in a removable appliance against a metal unit in the target tooth for vertical attraction.[32,33]

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Fig 1 Panoramic radiograph of the patient before treatment with a long-span failing metal-ceramic restoration.

Since it is difficult to design a fixed provisional prosthesis without the existence of stable adjacent teeth for performing the required extrusive movement, another option is to use mini-implants as the anchorage source.[34] The latter was selected for the management of this clinical challenge.

Mini-Implants

Mini-screw implants or temporary anchorage devices (TADs) are small-sized screws made of titanium or stainless steel. The use of mini-implants introduced new directions in orthodontic anchorage and treatment in general.[35] Paradigms have started to shift in the orthodontic world since the introduction of mini-implants in the anchorage armamentarium. They allowed the management of wider discrepancies because force can be applied directly from the bone-borne anchor unit. Mini-implants have also enabled clinicians to gain good control over tooth movement in three dimensions. These anchoring devices were incorporated reasonably in adjunctive orthodontic treatments in adult patients.[36]

It must be acknowledged that scientific data and controlled clinical trials related to this technique are lacking, although reports on the routine use of TADs clinically are quite common.[37] The primary fixation in the bone is mainly mechanical and osseointegration is neither claimed nor expected. Consequently, TADs are removed after use.[38]

Mini-implants differ in length, diameter, and head design. Prior to their insertion, careful planning is required for the proper application of force in the right direction and selecting bone sites for placement. Screw diameter and length along with head design are also important considerations for immediate anchorage and for convenient access to the remaining exposed head, which is regarded as the anchoring point.

Avoiding any harm to teeth roots and near anatomical structures is a key factor since damage to a root or its periodontal ligament can occur during placement. Even placement too close to an anatomical structure can become a possible complication. Other concerns include screw loosening before the end of treatment, screw fracture (considered a rare complication), and tissue overgrowing the implant head, especially when the mini-implant is placed in unattached mucosa. It may therefore be stated that the most important aspects when using TADs are their placement, position, and length.[35,37–39]

Clinical Case History

A 61-year-old female patient presented with an old, failing maxillary metal-ceramic fixed prosthesis (Fig 1). Following extractions and decay removal, the old prosthesis was readapted and relined with autopolymerizing acrylic resin on the remaining abutment teeth, including the two anterior hopeless central incisors.

Following the patient's request to receive fixed restorations, the tentative treatment plan was to replace missing and hopeless teeth with an implant-supported prosthesis and make a four-unit crown fixed partial denture from the maxillary left canine to the first molar, avoiding the need to augment bone in this area—a significant increase in treatment time and costs.

For correct placement of crown margins on sound tooth material, the maxillary left canine abutment tooth demanded either a crown lengthening procedure or forced root extrusion (Fig 2). Investing efforts in retaining this canine were discussed with the patient, who was aware of all of the possibilities and the relative prognosis. The quality and length of the canine's remaining root and the good standing position of the vital left first molar allowed the consideration of a four-unit fixed partial denture once a correct ferrule was

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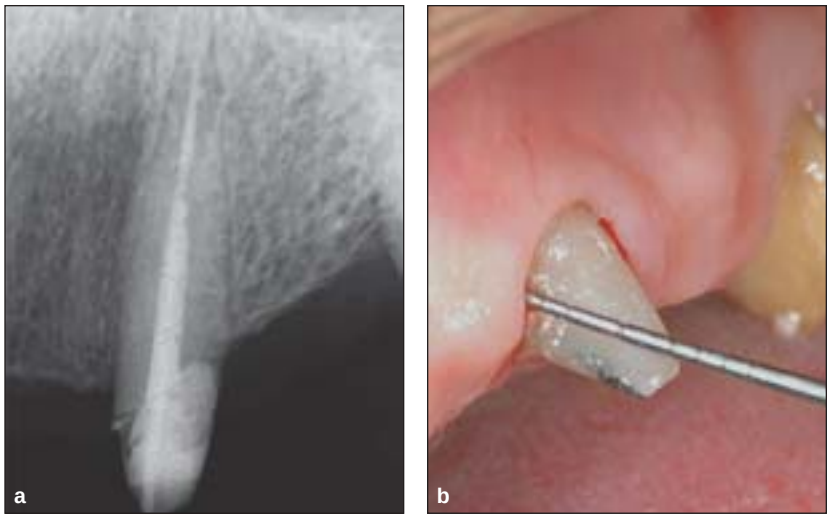
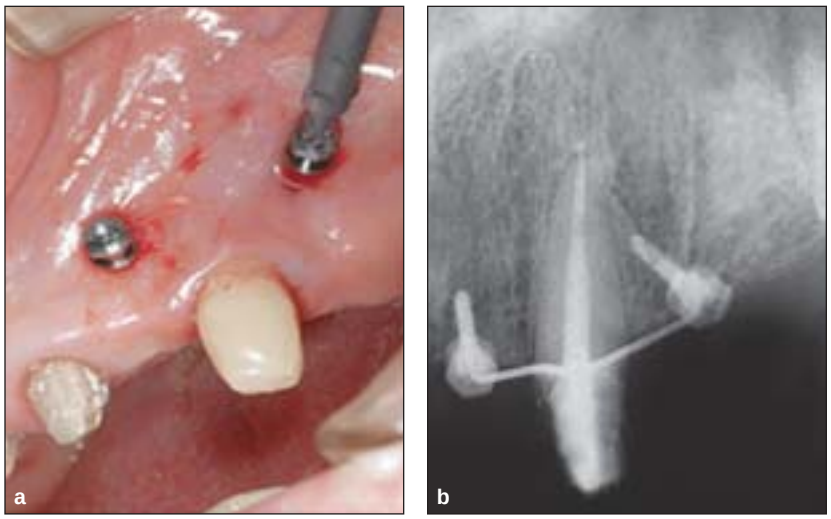


Figs 2a and 2b **(a)** The maxillary left canine with a composite material core buildup presenting a lack of sound tooth material cervically, which is imperative for restorative needs. **(b)** The probe presents the minimal available sulcus.

Fig 3 The modified provisional old metal-ceramic restoration and the individual acrylic resin provisional restoration on the maxillary left canine allowing directly isolated orthodontic movements.



Figs 4a and 4b **(a)** The placement of two mini-implants as anchoring devices for root extrusive movement. **(b)** The radiograph presents secure placement with no harm to the root.

established following treatment. Extrusion as a treatment option is preferred in such an event not only due to better crown-to-root ratio results, but also because it preserves the bone in the area.[16,30,40]

The alternative of fabricating a metal-reinforced acrylic resin provisional restoration was discussed but ruled out due to costs and the experience with the relined existing porcelain-fused-to-metal (PFM) prosthesis during the early treatment phase. Obviously, a provisional reinforced restoration could have been modified easily for extrusion purposes against an embedded bar.[41] The resolution of the problem with magnets was also discussed but the patient opposed any removable appliance, as is needed for this option.[32,33] Postponing the procedure to a later stage past implant placement was considered unfavorable following the need for immediate ferrule.[18,19,42] Thus, it was decided to force erupt the canine with the latter course, necessitating the placement of mini-implants for appliance anchorage purposes.

The existing fixed dental prosthesis was hollowed out around the maxillary left canine abutment while retaining its metal substructure, thereby allowing it to function provisionally. A modified acrylic resin crown was prepared for the tooth free of any contact with the metal frame of the cross-arch provisional restoration (Fig 3). Two mini-implants with a head transverse tunnel (Forestadent) were placed in the keratinized attached gingiva, one on each side of the root just coronal to the mucogingival line (Fig 4). A rectangular 0.16 × 0.22-inch wire (Forestadent) was adapted and soldered in a "T" form to vertically extrude the tooth using a coil

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Fig 5 The extrusive appliance with the two TADs in place at the onset of movement. Note the soldered "T" form of the wire to allow the coil spring activation for movement.

Fig 6 The maxillary left canine 4 weeks postmovement and mini-implant removal, refunctioning again as an abutment tooth. Note the proper ferrule established in the extruded tooth and tissue health.

Fig 7 Implant placed as part of the overall treatment towards maxillary fixed restorations on teeth and implants.

Figs 8a and 8b The maxillary left canine **(a)** 4 weeks postmovement and **(b)** 8 months later with an implant placed as part of the overall treatment.

spring against the bar between the two mini-implants and a bracket engaged onto the canine's acrylic resin crown (Fig 5). One week after the onset of movement, the circumferential fibers were severed to withhold the attachment apparatus from following the extruding tooth.[25,26] This action was performed twice more during the 6 weeks of extrusion.

The extruding movement was stopped once a ferrule of 2 mm was established, permitting the extruded tooth to be recruited into the provisional restoration. The recruitment was performed 4 weeks after the end of movement, during which the tooth stabilized uneventfully. By becoming a part of the teeth supporting the provisional restoration, further stabilization of the extruded tooth was gained.[43]

After the treatment goals and tooth stability were achieved, the mini-implants were removed using the insertion driver (Fig 6) and additional overall arch treatment was continued by placing implants towards a full-mouth fixed rehabilitation. The final treatment selected was as planned, a four-unit PFM fixed prosthesis from the extruded maxillary left canine to the first molar and an implant-supported fixed partial denture from the left lateral incisor to the right second premolar (Figs 7 and 8).

Discussion

Sound tooth structure coronal to a tooth's attachment mechanism must be available for restorative needs. The technique of forced eruption is indicated for correction of a nonrestorable tooth since the tooth can be elevated from its socket so as to raise the defect sufficiently high enough above the alveolar crest without changing the bony level.[16,17] This is achieved by using greater extruding forces and a more rapid movement in combination with a fiberotomy. Such a resection of the supra-alveolar fibers stretched by the extruded tooth

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is believed to eliminate tensile stress on the alveolar crestal bone, and serves to prevent the gingival unit's tendency to follow the tooth movement with the apposition of bone in the alveolar crest area.[25,26,29] Gingival status must be evaluated at the end of the extrusion process to determine the necessity of a corrective osseous surgical procedure. Supracrestal fiber resection in the rapid extrusive movement may very well accelerate reaching the desired position. This is not the primary objective of the fiberotomy but an expected favorable result,[26] which also reduces the relapse tendency.[28] A randomized clinical trial comparing two groups of orthodontic extrusion, one with and one without a fiberotomy, clearly confirmed the advantage of circumferential fiber severance.[30]

The forced eruption technique relies on stable and healthy neighboring teeth for anchorage. When adjacent teeth are absent, acquiring anchorage for the procedure becomes an issue, especially when the existing teeth support a provisional fixed prosthesis. In this case history, isolating the subjected tooth for eruption demanded changes in any provisional restoration, with a loss of occlusal support and the patient's comfort. Designing a removable orthodontic appliance was also considered. However, this would have relied entirely on the patient's compliance and acceptance, as well as a possible compromise of the remaining existing teeth, whose position and number were unfavorable. Using magnets, a possible option for the procedure,[32,33] would have demanded a removable acrylic resin restoration and was opposed by the patient. Again, this method might compromise the remaining teeth. Furthermore, a crown lengthening procedure was excluded due to the associated reduction in the canine's bone support, which was intended to be used as the anterior abutment for a four-unit posterior fixed prosthesis.[40] Further validity for this clinical decision was gained as a result of the intention to place an implant mesial to the canine, thus guarding valuable bone.

Conclusion

The use of mini-implants as orthodontic anchorage for forced extrusion treatment plans has proven to be very useful, especially in clinical situations where adjacent tooth anchorage is unavailable. An associated fiberotomy helps maintain exclusive tooth extrusion without the need for a corrective surgical procedure. In the described patient, the extruded tooth was reconnected to the fixed provisional prosthesis when the desired movement was achieved. The rest of the planned prosthodontic protocol was then carried out.

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Literature Abstract

Health behaviors of head and neck cancer patients the first year after diagnosis

This cohort prospective study evaluated five health behaviors (smoking, problem drinking, nutrition, physical activity, and sleep) in head and neck cancer patients at baseline and 1 year after diagnosis. Two hundred eighty-three newly diagnosed patients participated in this study and were recruited from the otolaryngology clinics at the University of Michigan Medical Center, Veterans Affairs Ann Arbor Healthcare System, and Henry Ford Health System. Demographic information and cancer-specific data regarding tumor site and stage were collected. Treatment information (chemotherapy, radiation, or surgery) and 1-year postdiagnosis presence of a feeding tube or having a tracheostomy was also recorded. Depression was measured using the Geriatric Depression Scale–Short Form and comorbidities were assessed using the Adult Comorbidity Evaluation-27. The five health behaviors were evaluated in the following manner: *(1)* smoking was based on if the patient reported smoking in the past month, *(2)* drinking was scored using the 10-item Alcohol Use Disorders Identification Test, *(3)* nutrition was evaluated based on mean daily calorie intake using the Willet food frequency questionnaire, *(4)* body mass index (BMI), *(5)* activity was measured on the Physical Activity Scale for the Elderly (PASE), and *(6)* sleep was evaluated using selected questions from the Medical Outcomes Study (MOS). Data were analyzed using descriptive statistics. Bivariate analyses were used to compare data differences from patients available for the 1-year follow-up, compared to unreachable subjects. Associations between independent variables were determined using separate logistic and linear regression tests. The subjects in this study had a mean age of 59, were mostly males, the majority were white non-Hispanic, over half were married, over half had a high school diploma or less, and most were from the medical center. The number of smokers decreased over 1 year (from 50% to 20%) along with problem drinkers (from 25% to 11%). Calorie intake per day decreased (2,100 to 1,828) as well as average BMI (26.6 to 24). Physical activity scores decreased about 25% 3 months postdiagnosis, but increased slightly over the baseline by 1 year. Sleep score remained consistent from baseline to the 1-year follow-up. Smoking and drinking were related to each other and to a low BMI. Sleep and physical activity were also related and low scores of either were related to depression. These results suggest that these health behaviors of head and neck cancer patients are interrelated and may be best treated as a set of problems rather than managed individually.

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