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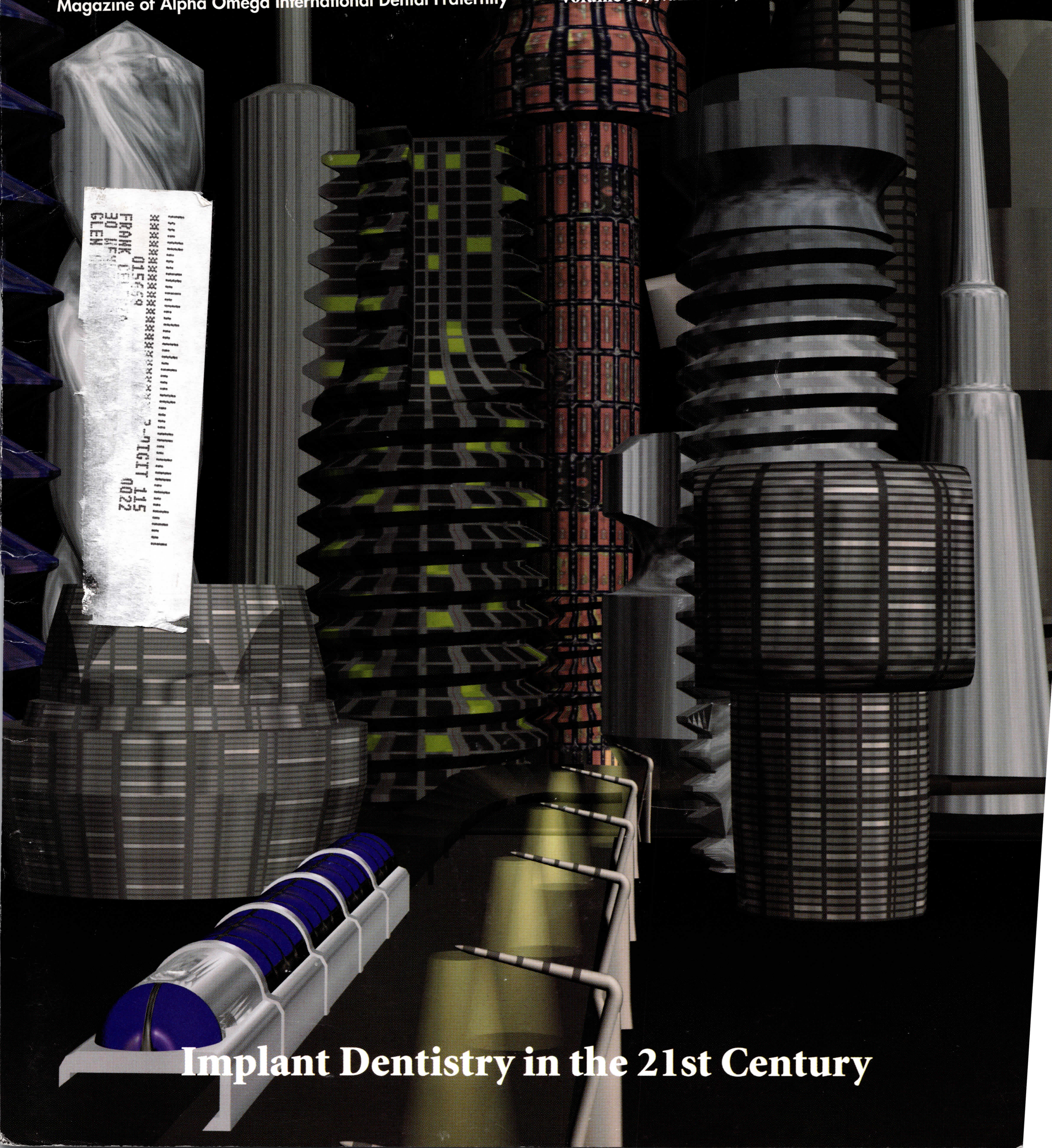


Implant Dentistry in the 21st Century

SCIENTIFIC ARTICLE

The Development of Forced Eruption as a Modality for Implant Site Enhancement

Frank Celenza, D.D.S.

Introduction

As a relatively simple form of tooth movement, forced eruption can be utilized to impart numerous beneficial alterations to both hard and soft tissues. In certain instances it is employed as an adjunctive orthodontic procedure, and in other situations it is combined with periodontal procedures. With an understanding of the use of these modalities, the astute clinician can arm himself with a simple tool to facilitate the treatment of otherwise problematic restorative and cosmetic conditions.

This paper will discuss the development of this technique and draw upon the insight gained from its utilization in various situations. From this body of knowledge, a rationale for the use of forced eruption in implant site enhancement will be developed and tested histologically to further add to the pool of information surrounding this modality.

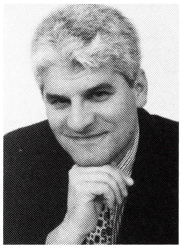
Historical Development

From a historical perspective, forced eruption has been described in detail throughout the dental literature[1–5] dating as far back as 1940.[6] The use of forced eruption was further popularized by a series of papers that clearly delineated its clinical indications.[7–9]

In part I of his series, Ingber wrote about forced eruption as a method to treat isolated intrabony defects.[7] Ingber diagrammed how the attachment apparatus can be utilized to impart a tension stimulus to the alveolar crest by orthodontically erupting a tooth. According to Wolfe's law, tension placed upon a bone will stimulate deposition. This has been demonstrated clinically, radiographically, and histologically[10–16] and is the basic reason why orthodontic tooth movement is even possible. Forced eruption harnesses this alteration to level intrabony defects orthodontically.

In part II, Ingber[8] demonstrated the use of forced eruption combined with periodontal surgery to effectively achieve clinical crown length on otherwise nonrestorable teeth. Significant cosmetic benefits were obtained.

Figure 1. Pretreatment radiograph of hopeless maxillary central incisors. Note that attachment to alveolar bone is present only in apical third.



Frank Celenza, D.D.S.

Dr. Frank Celenza enjoys the unique distinction of being certified in two dental specialties. He received his certificate of Periodontology from the University of Pennsylvania and his certificate of Orthodontics from New York University. He maintains a private practice in Manhattan. He is actively involved in teaching, and holds appointments in two postgraduate divisions at New York University, Orthodontics and Implantology. He has lectured extensively both nationally and internationally, authored papers in dental journals, and mentored numerous research projects.

Dr. Celenza and his wife Michele have two children, Nicholas and Olivia. Extracurricularly, he has a passion for motorsports, cycling, and computer technology.

In a follow up article,[9] Ingber showed how forced eruption can be employed to cosmetically alter free gingival margin location.

In 1984, Polson et al.[17] demonstrated that only alveolar bone that is attached to a tooth root by ligament fibers will accompany the tooth in its movement. By applying this principle to combine forced eruption with a modified supracrestal fiberotomy (as originally described by Edwards[18]) Pontoriero et al.[19] showed that the morphology of the alveolar crest can be controlled and remodeled.

As a logical progression of this information, Salama and Salama[20] documented clinical cases employing forced eruption on hopeless teeth to augment bony tissue in implant sites. They introduce a classification for extraction sockets according to their morphology. This classification is used to direct the clinician in selecting modalities for predictable implant placement into these sockets.

The following case, Figures 1–6, is the ultimate extension of this technique; the utilization of forced eruption to cause the previously described hard and soft tissue changes to help to develop implant sites. In effect, hopeless teeth are orthodontically extracted, augmenting hard and soft tissues in the wake during their process in situ.

Figure 2. Posteruption radiograph. Compare to Figure 1. Note that central incisors have been extruded beyond the alveolar crest, resulting in hard tissue socket fill.

Site Development Rationale

The fact that tension stimuli applied to alveolar bone causes bone deposition is central to the rationale for the use of orthodontic force as a means to attain bone fill in extraction sockets. Although subject to advanced periodontal disease rendering the tooth hopeless for preservation, the tooth is not necessarily useless in the patient's treatment. Even if healthy attachment apparatus is present only in the apical group of periodontal ligament fibers, that minimal zone of attachment can facilitate socket fill when subjected to extrusive forces.

Furthermore, soft tissue changes can be demonstrated and are manifested as gingival augmentation. This tissue alteration was first described by Atherton[21,22] and is a result of the nonkeratinized sulcular epithelium everting outwards as the tooth is erupted, then keratinizing after being exposed to the oral cavity. Immature nonkeratinized marginal gingiva can often be observed during the active phase of orthodontic eruption. Abundant newly formed gingival tissue such as this can facilitate primary flap closure at the time of implant placement, and is beneficial as a stable zone of attached gingiva.

Histologic Evaluation

The central incisors were forced erupted for a period of 12 weeks. At that time it was determined that the teeth were soft tissue born, and attached through epithelial means only. In effect the teeth were "extracted orthodontically" over this time period. After extraction, soft tissue socket

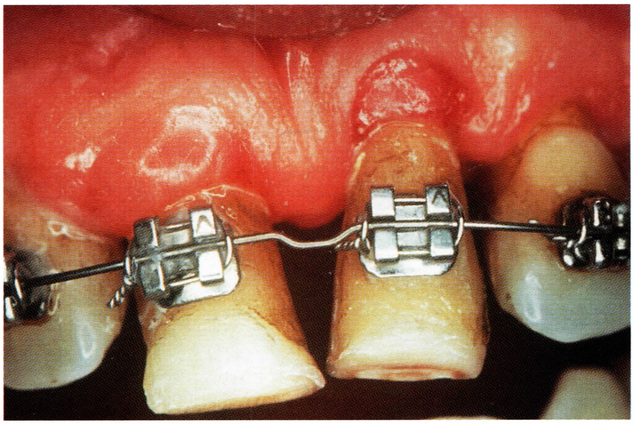


Figure 3. Clinical photograph after orthodontic eruption. Note bracket position, which has been relocated during therapy apical to the cementoenamel junction on dentin to fully express extrusion. Observe the formation of new gingiva (Atherton tissue) at this stage of nonkeratinization.

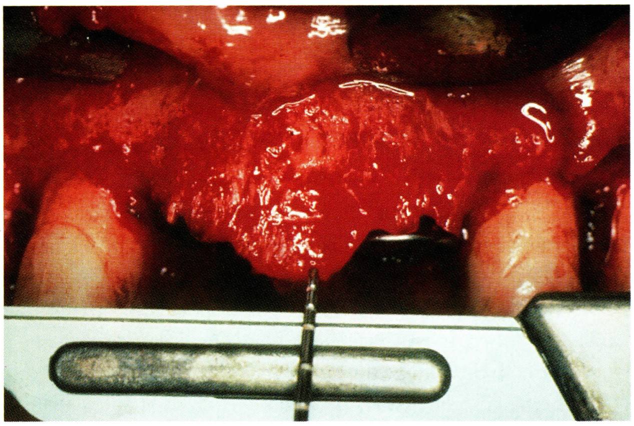


Figure 4. Four months after extraction, at the time of Stage I implant surgery. Note newly formed alveolar bone and reversal of osseous architecture in previously compromised areas.

healing and hard tissue calcification were allowed to proceed for a period of 8 weeks. Stage I implant surgery was then performed, and the implant sites were carefully studied. Rather than prepare the implant osteotomies by drilling with spades, a trephine was employed to remove a core of newly formed bone formed as a result of forced eruption. This core was prepared for histologic section and newly formed bone was observed. The findings are significant in that the bone is viable (living) bone as evidenced by the presence of osteocytes within each bony lacunae. Histologic sections of many types of allograft and even autografts fail to demonstrate this vitality. Moreover, reversal lines within the bony grain are indicative of bone formation in response to some outside stimulus, in this case orthodontic force.

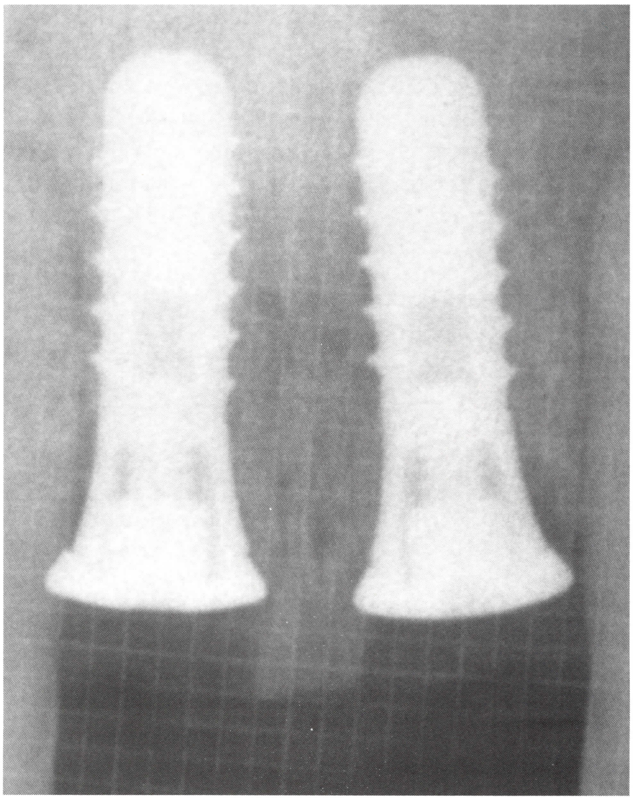


Figure 5. Radiograph of implants in place (placement by Dr. Robert Horowitz).

Conclusion

Orthodontic tooth movement can impart beneficial morphologic alterations. Whereas orthodontics can not be considered as a means to achieve new attachment in a periodontal therapeutic sense, physiologic modifications to both hard and soft tissues can be harnessed. The use of

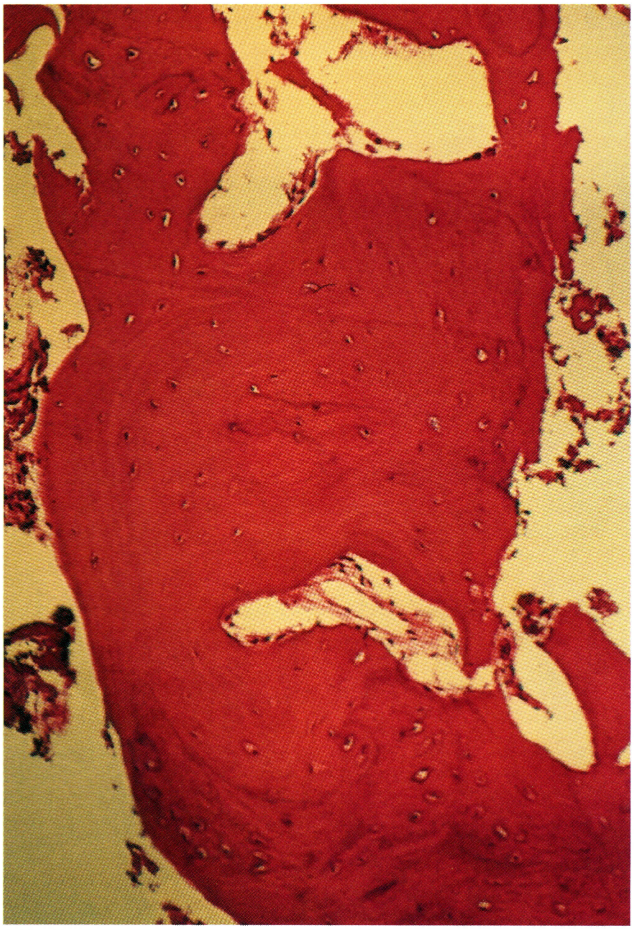


Figure 6. Histologic section. Two findings are of interest: the appearance of reversal lines that denote bone formation directed differently from grain of original bone, (implying an outside stimulus, which in this case is orthodontic force), and the presence of osteocytes within each lacunae (which indicates living bone).

forced eruption has been examined to illustrate the variety of these remodeling phenomena. The extension of this technique as a means to orthodontically extract hopeless teeth so as to augment potential implant recipient sites is explored histologically.

The utilization of the body's natural reparative mechanisms to alter morphology demonstrates advantageous results.

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