editorial commentary

Orthodontically Induced Gingival and Alveolar Augmentation: Clinical and Histological Findings

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Dental surgeons continue to seek advances in implant site development, which will eventually result in enhanced implant placement that will support functional, aesthetic placement of restorations. The number of treatment alternatives that facilitate implant site development modalities continues to grow. Correct diagnoses and selection procedures that appropriately manage a variety of clinical situations (eg, vertical and horizontal ridge deficiency, soft tissue deficiencies, sinus and alveolar nerve proximity) will best serve the well-prepared clinician. Current procedures include bone grafting (with and without membrane barrier enhancement), ridge splitting, osteotome instrumentation, and a variety of sinus floor elevation techniques. In addition, distraction osteogenesis — although in its infancy — demonstrates great potential. While there is no single augmentative, regenerative, or reconstructive procedure currently available to correct every bone defect, the aforementioned procedures can successfully correct various defects and deficiencies.

Salama and Salama[1] suggested the use of orthodontic extrusion as a means of repairing severe socket defects prior to the extraction of hopeless teeth. This technique represents the ultimate extension of the well-documented advantages of forced eruption. Forced eruption has been effective at leveling osseous defects,[2] salvaging nonrestorable teeth,[3] and altering free gingival margin levels.[4] Perhaps the greatest advantage of this procedure is that it harnesses the body's own ability to repair and reconfigure tissue in response to orthodontic movement. The development of forced eruption as a means for site development has been previously discussed, and favorable alterations to both hard and soft tissues have been demonstrated.[5] This article demonstrates the importance of a histological evaluation of the hard tissue generated in response to orthodontic tension.

Materials and Methods

Forced eruption for site development has traditionally been employed for teeth that were deemed hopeless

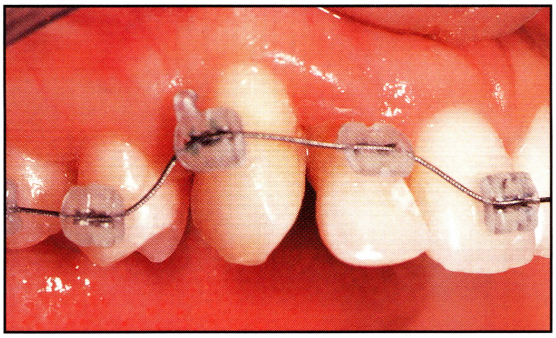

Figure 1. Preoperative view of the maxillary right region indicates advanced periodontal disease that involves the lateral incisor and canine. Arch wire deflection displays the activation of the appliance for eruption.

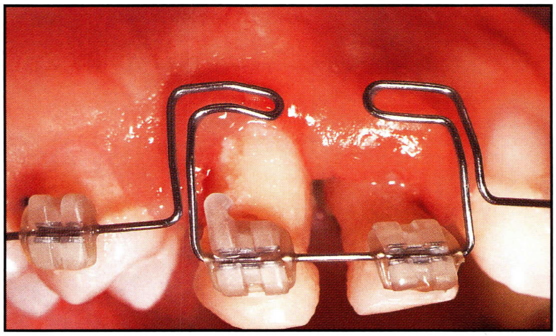

Figure 2. Postoperative view following eruption. Note the change in bracket relations inciso-apically and the corresponding alteration of the free gingival margin levels.

and slated for extraction and subsequent implant replacement. When severe socket defects or the absence of buccal bone were anticipated, the eruption of the hopeless (but still useful) teeth to the point of orthodontic extraction has proven beneficial.[1]

Patients who presented with advanced stages of periodontal disease around isolated teeth were slated for implant replacement (Figure 1). The hopeless teeth were orthodontically erupted as far as possible and in many cases, to the point of orthodontic extraction (Figure 2). This was accomplished over a 3- to 4-month period. Following extraction (whether accomplished orthodontically or by surgical severence), healing of the area was allowed to occur for a period of 4 to 6 months. During Stage I implant placement, bone core specimens were acquired, preserved, and harvested with a trephine for histological evaluation. Implant placement and restoration were completed in accordance with conventional methods (Figure 3).

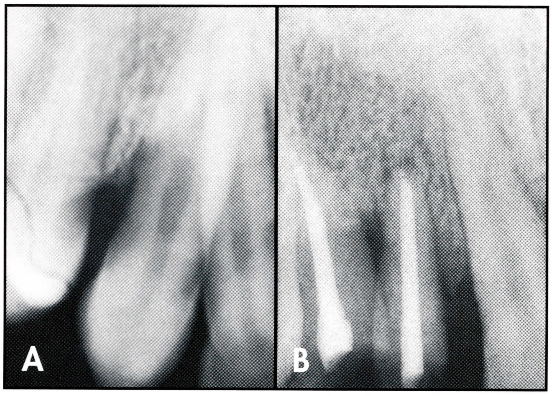

Figure 3A. Preoperative radiograph indicates advanced bone loss and poor root relation. 3B. Postoperative radiograph illustrates significant alteration of alveolar bone, displaying orthodontically induced augmentation.

Case Presentation

Case 1

A 28-year-old male patient presented with advanced periodontal disease that involved both maxillary central incisors (Figure 4). Bone loss was radiographically apparent into the apical third on some surfaces. Significant orthodontically induced augmentation of both gingival and alveolar tissues was evident, and eruption continued to the extent that the brackets were eventually bonded to the root surface (Figure 5). Surgical intervention was required during implant placement, a bone core was acquired for histological analysis, and the implant fixtures were placed (Figures 6 and 7).

Figure 4. Case 1. Preoperative facial view of the central incisors with gingival recession. Advanced stages of periodontal disease were noted.

Results

Orthodontically induced augmentation was beneficial for hard and soft tissue modification. Gingival augmentation resulted from the eversion of sulcular epithelium. As noted in previous investigations,[6,7] this nonkeratinized tissue underwent maturation upon exposure to the oral cavity to form keratinized gingiva.

Hard tissue formed through orthodontic induction was further analyzed in the aforementioned cases. The core of bone tissue obtained by the introduction of the trephine bur to the implant site functioned as an informative specimen. Theoretically, this specimen represented

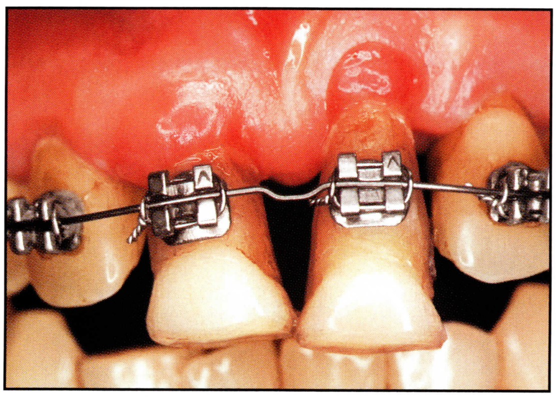

Figure 5. Facial view following eruption. Note that the eruption has continued to the point that the brackets were eventually bonded to the root surface, apical to the cemento-enamel junction.

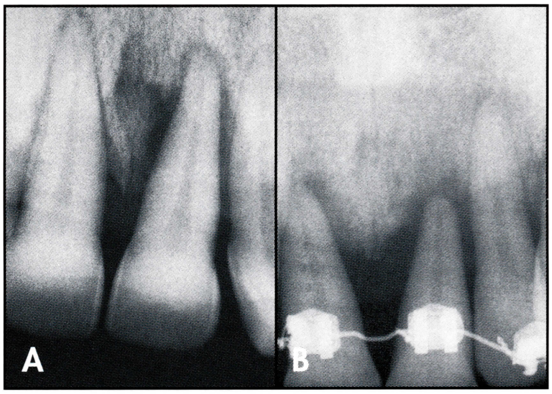

Figure 6A. Preoperative radiograph indicates advanced bone loss and poor root relation. 6B. Postoperative radiograph illustrates significant alteration of alveolar bone, displaying orthodontically induced augmentation.

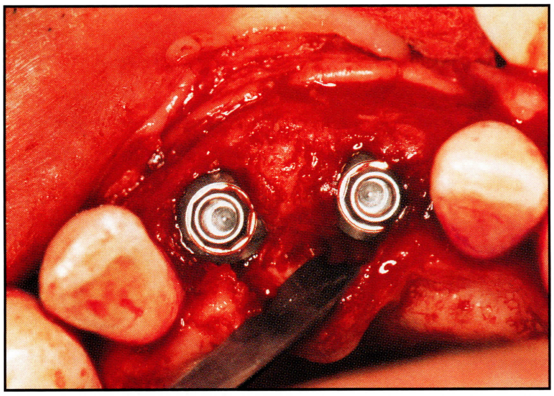

Figure 7. Implants were placed into the orthodontically induced tissue augmentation. Additional bone grafting was not required.

Figure 8. Histologic view of bone tissue that was orthodontically induced. Note the presence of osteocytes within every lacunae that indicate the ability to form living bone in response to orthodontic induction.

a gradation of bone maturation since the length of the core closest to the apical extent represents older, mature bone, while the most recently generated bone was located further crestally. The consistent presence of osteocytes in every lacunae of the newly formed bone was histologically evident (Figure 8). This finding was of paramount importance, as it clearly demonstrated that the bone formed by orthodontic induction was, in fact, living bone.

Conclusion

Although the use of forced eruption for implant site development has been previously proposed, significant gingival augmentation was apparent in the aforementioned cases. The hard tissue augmentation that resulted from orthodontic induction was analyzed histologically, and was living and viable in nature. The results of this evaluation indicate that new bone generated as a result of orthodontic extrusion/extraction is functional. The generation of this type of bone will significantly influence the overall success of implant treatment, which subsequently increases the treatment options available in the restorative armamentarium.

Acknowledgment

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