Often orthodontists can be of considerable assistance in periodontal and prosthodontic treatment. The orthodontists’ principle periodontal objective with so-called facilitative care is to reduce or prevent excessive periodontal surgery by establishing a physiologic alveolar crestal topography. This can be done by recognizing the effect of orthodontic tooth movement (OTM) on the alveolar topography and engineering the desired contour with selective force gradients in concert with minor periodontal surgery. With this synergistic orchestration between specialties the prosthetic foundation is more stable, the esthetic contour of the gingiva is improved and, most important, unnecessary removal of alveolar bone is avoided because pathologic contours due to tooth malalignment are eliminated prior to osseous surgery.

Case studies are integrated herein with emerging 21st century concepts of periodontal tissue engineering (Semin Orthod 2008;14:272-289.) © 2008 Elsevier Inc. All rights reserved.

Often orthodontists can be of considerable assistance in periodontal and prosthodontic treatment. Dental alignment of the arches can facilitate prosthodontic objectives, a strategy referred to as “facilitative orthodontics.”

The latter is not done simply to facilitate a path of insertion of a prosthesis. The orthodontists’ principle periodontal objective with facilitative care is to reduce or prevent excessive periodontic surgery by establishing a physiologic alveolar crestal topography.

However, the orthodontic perspective is often omitted from treatment planning in cases of periodontic-prosthodontic collaboration. This may be due to many factors both cultural and professional. The periodontist, prosthodontist, or general dentist may not be aware of what is possible from orthodontics, or the orthodontist may simply decline participation in limited objective therapy. Also, on a most fundamental educational level, most orthodontic graduate programs spend the majority of the curriculum with adolescent therapy and do not have an understanding of the special needs of the periodontal and prosthodontic communities.

Adding another specialist in a comprehensive treatment plan can also reduce case acceptance because of the increased cost. However, patients who appreciate the difference between price and value (utility/cost) and the nuanced intellectual distinctions among financial, biological, opportunity, time, and morbidity costs can be discriminating enough to appreciate the professional effort. Even where such considerations are dismissed as impractical, too theoretical, or arcane, at the very least it is incumbent on the ethical professional to ensure that patients decline such care only after being fully informed of all treatment alternatives.

This article will explain, against the background of special periodontal therapy and a case study method, what the orthodontist can provide and where the orthodontist is an integral part of the periodontic-prosthodontic treatment. Orth-
odontists who want to participate will be enhanced ethically, financially, and intellectually. Moreover, and perhaps most importantly, the orthodontist will find it professionally gratifying to extend his or her professional skills into a broader therapeutic perspective.

History of “Facilitative Orthodontics”
In 1923, Dr. Isador Hirschfeld, a periodontist, reported that the position of the teeth in their spatial relation to the alveolar process can affect the shape and location of the periodontium. In the 1950s many periodontists hypothesized that perhaps one could change abnormal, nonphysiologic topography of the periodontium by changing the alignment of the roots. In essence, the tooth would be used as a “handle” to push or pull the healthy periodontium to the new desired position or shape (within a phenotypic potential). With this insight a whole new type of periodontal treatment was developed in which the orthodontist could participate.

One of the first reported uses of this novel approach, published by Brown in 1973, was the reduction of mesial periodontal defects by uprighting mesially inclined molars. Technically the mesial tipping produces only a gingival or pseudopocket if no periodontal attachment has been lost. However, a pocket deeper than 3 mm produces microecosystems that promote the growth of periodontal pathogens and subsequent attachment loss.

Mesial tipping is the first link in a pathologic causal chain, but in a multifactorial causal system the tipping is best referred to as a risk factor. Figure 1 shows the reduction of the pocket with uprighting of a mandibular second molar done by the present author while in graduate school in the early 1970s. If the pocket is eliminated with surgery alone, excessive bone must be removed, which can adversely affect more anterior teeth.

Salient Periodontal Issues in Orthodontics
Abrupt changes in bone topography, caused either by malocclusion or periodontitis, are not followed by the overlying gingiva; this discordance between soft tissue and subjacent bone creates pockets. Even in an infection-free dentition, arch length deficiencies cause this bony distortion and pocket formation. An alternative to uprighting molars, or leveling and aligning teeth in each arch, is to take away unnecessarily greater amounts of supporting bone (and, by definition, part of the healthy periodontal ligament) on the bicuspids and other teeth. Figure 2 illustrates these two alternative treatment approaches. Bone removal usually has to be extended and contoured over several teeth to surgically eliminate abrupt changes in form and create a physiologic topography conductive to periodontal health.

All periodontal patients scheduled for osseous resective surgery should be given the option...
to undergo some orthodontic care to obviate the chance of unnecessary alveolar bone removal. Figure 3 illustrates how, as molars drift mesially, they tip gingivally and a pseudopocket (gingival pocket without attachment loss) will form on the mesial aspect since the crown drifts on a mesio-apical trajectory. This promotes plaque retention and results in attachment loss, deepening the pocket even further.

Orthodontic Elimination of Gingival Pockets Caused by Dental Crowding

If the “piling up” of soft tissue on the mesial aspect of the molar can be reversed by molar uprighting, excessive osseous surgery can be avoided. Ingber extended the concept to the apico-coronal dimension, introducing the concept of “forced eruption” as a method of treating one and two walled osseous defects (Fig 4). He later reported in 1976 that forced eruption could enhance clinical crown lengthening, presently a popular technique, which addresses important prosthetic concerns. This enhances both esthetic values and function while decreasing morbidity associated with the inadequate crown mass that reduces prosthesis retention.

To create clinical crown lengthening without orthodontic therapy, usually bone and soft tissue must be removed around two teeth mesial and distal to the affected tooth, thus worsening their periodontal status and esthetic result (Fig 5). By extruding the tooth first, bone and soft tissue attachment is affected on only the crown-lengthened tooth and the esthetic outcome is maintained. The bone and soft tissue follow the root of the treated tooth and no surgery is needed on the adjacent teeth.

Figure 2. If orthodontic uprighting is not done as shown in the bottom image, then excessive amounts of bone must be removed during osseous surgery. Bone coronal to the red inferior line represents the amount of bone that is removed by standard osseous resection when no orthodontic treatment is used to upright the molar. The coronal and apical white lines represent the cemento-enamel junction and alveolar osseous crest, respectively. (Color version of figure is available online.)

Figure 3. (A) Note the deep vertical bony defect on the mesial of the tilted molar. (B) Note how much healthy alveolar bone had to be removed in this case because the patient did not elect orthodontic uprighting before comprehensive prosthodontic-periodontal therapy with facilitative orthodontic care. The excessive surgical morbidity of this case could have been reduced with orthodontic molar uprighting and selective decortication. (Color version of figure is available online.)
Thus, only one tooth is involved in surgery and not four to five.

In 1987, Pontoriero and coworkers\textsuperscript{5} reported that repeated gingival fiberotomies (minor incision gingival fibers) can prevent the coronal displacement of the gingiva and attachment apparatus with the tooth during orthodontic extrusion; 2 years later Ingber\textsuperscript{6} reported on forced eruptions as a means to improve cosmetic periodontal deformities (Fig 6). This author\textsuperscript{7} has combined Ingber’s technique of extrusion for vertical defects with Pontoriero’s technique of repeated fiberotomies to prevent coronal movement of the periodontium on a different aspect of the same tooth where a normal periodontium presents. Without this critical modification, treatment can create iatrogenic gingival pockets distally as mesial pockets are eliminated by uprighting.

**Figure 4.** (A) Illustrations from Ingber’s definitive articles (1974) illustrate the relationship between the alveolar crest attached to the root in a one-walled infrabony defect (vertical or angular bone loss) and the effect of facilitative extrusion. The interdisciplinary synergy between the periodontal and orthodontic specialties has made this low-morbidity treatment feasible. (B) To eliminate the vertical defect (dotted line) the surgery must involve four more teeth (solid line) to blend the architecture.

Thus, only one tooth is involved in surgery and not four to five.

Figure 5. (A) Crown lengthening with surgery only. Note the inconsistent gingival margins (yellow arrow at c) on the maxillary central incisors in this schematic when only surgical apical positioning of the gingival margin is employed to lengthen the clinical crown. (B) The tooth is extruded first above (yellow arrow). Surgery is then done on only one tooth. (C) Surgical flap on adjacent teeth visualizing alveolar bone extruded with tooth root. Primary closure of the flap follows. (Color version of figure is available online.)
Case 1: Orthodontics as an Aid in Minimizing Surgical Morbidity (Fig 7)

The patient in Fig 7 presented with a vertical osseous defect on the mesial aspect of the maxillary lateral incisor. The tooth was orthodontically extruded to bring the bone on the mesial defect to the normal level of the adjacent teeth as advised by Ingber. However, repeated fiberotomies were performed only on the distal aspect, an intact periodontium, to prevent it from moving incisally, thus maximizing esthetics results. Unfortunately, many periodontists today still provide crown lengthen-

Figure 6. Leveling of the gingiva by extrusion of the lateral incisors. Note inconsistent gingival margins on lateral incisors, left (yellow) arrow, and consistent margins, right (green) arrow, after facilitative orthodontic management. (Color version of figure is available online.)

Figure 7. Extrusion with partial fiberotomies to eliminate mesial osseous defect and produce a normal level of the periodontium. Alveolar bone comes with the extruded surface of the tooth that has an infrabony defect, left arrows (black). Partial fiberotomy on opposite proximal surface keeps bone at consistent level, arrows (red). (Color version of figure is available online.)
ing for prosthetic reasons with only osseous sur-
gery that adversely affects four more teeth as was
shown in Fig 5a. This is because many periodontists
have not been trained to proficiency in orthodontic
techniques or have not been influenced by an orth-
odontist who is familiar with periorthodontic theory.
The progressive orthodontist can help end this aca-
demic deficiency simply by communicating basic
tooth root movement–bone response concepts.

**Case 2: Orthodontics as an Aid in Correcting
Biological Width Violations**

The patient in case 2 presented to the periodon-
tal office for a fifth opinion regarding her gin-
gival recession and inflammation. That she had
three sets of crowns placed, all causing biologi-
cal width impingement and further recession
(Fig 8). The four previous periodontists recom-
mended more surgical crown lengthening to cor-
rect the biological width impingement, which of
course would only cause more recession. A combi-
nation of Pontoriero’s extrusion with fiberotomies
to correct the biological width violation and Ing-
ber’s cosmetic extrusion was recommended to
level gingival margins.

The first photograph shows the gingival re-
cessions and biological width violation on the
patient’s left maxillary lateral and central incisors (numbers 7 and 8). Extrusion with fiber-
rotomies was first performed to correct the
biological width violation. Then the teeth were
further extruded to bring the gingival margins, coronally, level with tooth numbers 9 and
10. The next photograph shows the correction of
the biological width problem and leveling of the
 gingival margins with provisional crowns (Fig 8).

**Case 3: Orthodontics as an Aid in Improving
Implant Sites (Fig 9)**

This patient presented to Salama (H) and
Salama (M), the former a dually certified pe-
riodontists and prosthodontist, the latter a du-
ally certified periodontists and orthodontist. 8
Their article described a very creative method
of tooth extrusion for implant site develop-
ment in a compromised alveolus. The method
applies Ingber’s forced eruption idea to in-
crease the dimensions of the local alveolus.

In this case there is external and internal resorp-
tion on the labial of the mandibular incisor giving

![Figure 8](image-url)
Figure 9. (A) Before extrusion of the lateral incisor (#23). Note the location of the cervical caries (arrow) at the osseous crest (dashed line) that would require crown lengthening and unnecessary bone removal without orthodontic extrusion. (B) Gingival margin 2nd alveolus are extruded coronal to adjacent gingival margins. Radiograph does not demonstrate extruded alveolar bone because it is not fully calcified. (C) Final prosthesis are seated and cemented to harmonious consistent gingival margins. (Color version of figure is available online.)
it a poor prognosis. If routine removal even with bone grafting were done, there would be a labial defect. By extrusion of the tooth over 7 mm there was sufficient, indeed an overabundance of hard and soft tissue enough to place an implant (Fig 9).

**“Minor” Orthodontic Crowding as a “Major” Periodontal Problem**

A narrow interproximal space present due to arch length or tooth size deficiencies may result in a constriction of the interproximal bone. The compromised bone resulting from a reduced interradicular distance can be a challenge for both periodontists and prosthodontists. This septal constriction is an iatrogenic compromise when orthodontists reduce interproximal contacts to the point where excessively reduced (stripped) proximal surfaces are dysfunctional and the gingival embrasure is moved apical to the interproximal gingival margins. Extending the embrasure this far apically provides a fertile niche for microbial biofilm proliferation beyond the reach of floss and scalers and compromises host resistance by reducing the vasculature of interproximal alveolar bone and its vasculature. Septal bone mass is also reduced where roots can migrate closer together due to interproximal caries or a local arch length deficiency (“slipped contact”). This deficiency may be trivialized or summarily dismissed by mechanically oriented clinicians as a so-called minor orthodontic or a simple “cosmetic” problem that can simply be covered up with a veneer or similar prosthesis.

**Case 4: Recognition of Crowding as a Periodontal Concern (Fig 10)**

Orthodontists must be aware of dental contact distortion from a biological and prosthodontic perspective not merely as an esthetic issue. A local problem may not be insignificant to the periodontist who has to regenerate bone since a narrow septum does not lend itself to regeneration as predictably as well-endowed interproximal bone.

The narrowed space also makes prosthetic restoration difficult, resulting in improper contours, tissue impingement, and food impaction. As the two adjacent cribriform plates of the tooth sockets (radiographically lamina dura) move closer together, there is a loss of medullary bone and its blood supply. If the patient is susceptible to periodontitis, this impaired bone can be lost very rapidly and the treatment becomes complicated. Widening of the interproximal bone simply by orthodontic alignment of the dental arch can greatly enhance local host resistance and thus the prognosis of an infected dentition (Fig 10). This is an important fact to appreciate, since of all the components of malocclusion, arch length deficiency, not cross bites or overbite/overjet deformities, is the most significant from a periodontic perspective. The treatment of interproximal tissue constriction and contact point/embrasure distortions is the principle periodontal reason to eliminate crowding. Interestingly, alveolus “deficiency” can be seen as an illusory and misleading term that presupposes a popular but mythical “geneti-

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**Figure 10.** (A) Note the widened interproximal space (between arrows) and (B) healthier bone produced by bodily distal-driving of the second molar with facilitative orthodontics.
cally fixed, small jaw/large teeth” fallacy. The arch displays “crowding” not because an immutable arch length is deficient; the malleable arch length is deficient because the teeth are crowded.

The small-jaw-large-teeth fallacy does not fit with the facts of alveolus ontogeny or guided arch development through the transitional dentition. In instances where the clinician may be unfamiliar with alveolus ontogeny, the alveolus is allowed to become deficient (deformed) by nonintervention. The elimination of crowding by leveling and aligning, an alveolus development exercise, is for the periodontally sophisticated orthodontist who sees orthodontic treatment as more than cosmetic, the most compelling periodontal rationale for orthodontic therapy. For these reasons, even limited orthodontic care is helpful to patients when the option for more comprehensive care is not possible.

The Importance of the Periodontal Tissues to Orthodontics

The importance of the periodontium to orthodontic care is comparable to the importance of civil engineering to architecture. However, for many mechanically oriented orthodontists the subjacent periodontium is often not considered sufficiently but merely as a distraction from efficient biomechanics. This misunderstanding or nonappreciation is in part due to whether this arena appropriately lies in the domains of periodontics or orthodontics. The opinion of many periodontists, including the present author, is that alveolus topographical engineering is periodontics with an orthodontic component. It is essential that orthodontic educational entities develop more explicit instruction in periodontology, alveolus development, and pathophysiology. Orthodontics is considered to be much more than simply an esthetic domain.

Case 5: The Use of Implant Supported Anchorage with Selective Decortication (Fig 11)

Orthodontic therapy can be greatly facilitated and enhanced with the use of prosthetic implants. The patient in Fig 11 presented with an anterior open bite and pathological migration (flaring) of the maxillary teeth. Endosseous implants in the molar areas can be used as anchorage to retract the maxillary teeth. Furthermore the anterior distorted alveolar architecture can be reengineered with periodontally accelerated osteogenic orthodontic augmentation (PAAO) surgery to produce regional acceleratory phenomenon (RAP), which results in a vast increase in osteoblast and osteoclast activity. Clinically this is manifest as a “softening” of the healing alveolus bone.

Figure 11. (A) Note the excessive overjet. (B) Prosthetic implants in the molar areas were used as anchorage to move the maxillary teeth distally. (C) Note the reduced overjet. (Color version of figure is available online.)
(A) Note the vertical maxillary excess and open bite. The treatment plan avoided consideration of orthognathic surgery positing the dentoalveolar complex (periodontium and alveolar bone) as a reactive organ separate from the subjacent skeletal maxilla. Thus, the morbidity of orthognathic surgery is considered excessive in relation to the patient’s sensibilities and chief complaint. (B) Note vertical impaction of posterior dentition with orthodontic temporary anchorage devices. The alveolus and periodontal structures (dentoalveolar complex) allows the alveolus to be molded as a separate “organ” using the teeth as “handles” to reshape the alveolar bone. Thus, reference to the “maxilla” in this sense is a misnomer. (Color version of figure is available online.)
Selective Alveolar Decortications versus “Old-Fashioned Corticotomy”

Periodontally accelerated orthodontic tooth movement combined simultaneously with osteogenic surgery can vastly improve the orthodontic outcome. The “new approach,” however, is often confused with an old 19th and 20th century procedure called corticotomy. Corticotomy was often a highly morbid, hospital-based procedure dictating surgical cuts made entirely through the buccal and lingual alveolar process periapically. The latter risked the devitalization of teeth as well as alveolar necrosis. Moreover some surgeons made such deep bony cuts interproximally that the orthodontist considered it regional orthognathic surgery. Since this unrefined technique lacked an evidence base and had a high morbidity, it justifiably enjoyed rather little popular support.

Tissue Engineering for the Orthodontic Specialty

To address the need for surgical orthopedics of the alveolus, a new, refined, and evidence-based technique is a much more gentle surgical procedure in which the periodontist uses a #2 round bur to place small superficial holes just barely through the cortical plate on the buccal and/or lingual sides of the alveolar process. This is done for the explicit purpose of engineering a therapeutic physiology, not to reposition or juxtapose bony parts. This point is paramount because the purposeful and permanent alteration of alveolar form to a novel design is achieved through a combination of somatic cell therapy (bone regeneration) and gene therapy (alteration of genetic expression). It warrants reiteration that modern selective alveolar decortication is not inspired, designed, or intended to move bony parts. Tissue engineering principles inherent in the PAOO protocol and periodontal regenerative science have delivered an entirely new dimension in dentofacial orthopedics. Moreover, the superficial scarification necessary to elicit a commensurate degree of “optimal response” is so benign that a practical and predictable alternative to hospitalization is now in the hands of enlightened orthodontists who...
can now legitimately add the term “tissue engineering” to the specialty lexicon.

Case 6: Treatment of an Anterior Open Bite (Figs 12, 13, 14)

This patient presented with occlusal contact on unilateral second molars and severe generalized gingival and bony dehiscences. Bony dehiscence and fenestrations can be visualized with cone beam volumetric computerized tomography (CBVCT), in the initial records (Figs 20, 21). If dehiscences or fenestrations are present in adults it would be wise to use PAOO before arch expansion. If thin alveolar bone is present and facial features permit it, bicuspid extractions can be justified. If, however, thick alveolar bone is evident in the cone beam computerized images, lower incisor proclination may be attempted with relative periodontal impunity.

Buccal and lingual flaps were reflected and the stippling in the bone was done with a #2

Figure 14. (A) Before: Note anterior open bite and gingival recession. (B) After: Anterior open bite closed and gingival recession improved. (Color version of figure is available online.)

Figure 15. Before: Note cross bite on right side with maxillary arch too small for mandibular arch. The patient also has pockets and gingival recession.

Figure 16. After: Cross bite and midline corrected. Pockets removed and mucogingival defects improved. (Color version of figure is available online.)
round bur from first molar to first molar in both arches to orchestrate a new and novel therapeutic alveolar ontogeny not possible with either periodontal surgery or orthodontic therapy alone. Graft material was then placed on the labial aspects of a decorticated alveolar cortex and selectively on the lingual aspects of the alveolus where more so-called alveolus “expansion” was needed. The patient also had gingival recession on most of her teeth. Therefore, soft connective tissue grafting was needed from first molar to first molar. The bone grafting material consisted of demineralized freeze-dried bone allograft (DFDBA; also commonly referred to as demineralized bone matrix [DBM] in medical orthopedics) and “extended” with a bovine-derived mineralized inorganic xenograft (Osteograft/N-300; CeraMed Dental, LLC, Lakewood, CO 80228). Palatal donor tissue was eliminated in favor of an acellular freeze-dried human dermis (Alloderm; Life Cell Corporation, Branchburg, NJ 08876).

Figure 17. (A) Before treatment photographs. Note patients flattened lower facial profile. Although bicuspid extraction may be unavoidable in teens, this congenital absence demonstrates possible developmental arrest since the development of the adult face is unpredictable. Consequently untoward and unforeseeable facial profile flattening can occur but happily is now reversible with outpatient periodontally accelerated osteogenic orthodontic augmentation (PAOO). (B) Note the anterior horizontal overjet. (Color version of figure is available online.)
This allograft soft tissue was then placed over the bone grafts and the flaps were coronally repositioned superficial to the allograft to treat recession, fortify the soft tissue-dense attached gingiva, and provide a more stable dentogingival junction at a more coronal level (Fig 14). The anterior open bite was easily closed in 7 months with no ancillary orthognathic surgery. Wilcko and coworkers\(^9,10\) contend that these results are more stable than orthognathic surgery and Murphy\(^11\) has explained the stability in terms of altered phenotype.

Figure 18. (A) Before periodontally accelerated osteogenic orthodontic augmentation (PAOO) surgery at 2 weeks. Note the midline shift and thin periodontium (so-called washboard effect), which often indicates bicuspid extraction therapy. (B) Full thickness mucogingival flaps reflected. (C) Selective alveolar decortication (SAD) just through the cortical plate with a #2 round bur initiates a therapeutic reversible regional osteopenia to accelerate OTM and enhance stability, the patient’s chief objective for selecting PAOO. (D) A demineralized freeze-dried allograft (also known as demineralized bone matrix or DBM) widens the alveolus process in the direction of desired tooth movement without affecting the subjacent maxilla. The alveolus is considered a separate operative “organ.” (E) Due to the preservation of the interproximal tissues and primary closure, there was little discomfort. (Color version of figure is available online.)
Case 7: Dental Crossbite (Figs 15, 16)
The patient in case 7, a 57-year-old Hispanic female (Fig 15) presented with a presumptive maxillary and manifest alveolus transverse deficiency (Angle Class III skeletal pattern), a dental arch that was “too small” relative to the mandibular arch homologue. A surgically assisted rapid palatal expansion was initially thought to be necessary to treat her with conventional orthodontics. However, because the patient was in her fifth decade of life, the osteogenic potential of the alveolus was deemed inadequate a priori so that buccal gingival

Figure 20. Orthodontic microimplant (TAD) acts as absolute anchorage to move the molars distally as coiled spring moves premolar mesially to open previous orthodontic extraction site and enhance flattened lower facial profile. (Color version of figure is available online.)

Figure 19. (A) Note the bony dehiscence top (green arrow) and fenestrations bottom (blue arrows). (B) Bone grafting to change the B point labially while lending stability, preventing gingival soft tissue dehiscence, and providing an alternative to bicuspid extraction therapy as lower facial profile is enhanced. (C) Primary closure with primary intention healing ensures minimal postoperative discomfort that often accompanies open surgical wounds and healing by secondary intention. (Color version of figure is available online.)

Figure 21. Final orthodontic treatment and preprosthetic treatment with nearly ideal overjet/overbite relationship. Murphy (2006)\textsuperscript{11} refers to this as an epigenetically engineered alternative regional phenotype (facilitative orthodontics). Note thickness of mandibular gingiva and cervical position despite mild marginal gingivitis. (Color version of figure is available online.)
recession and generalized bony dehiscence precluded rapid palatal expansion (RPE) of any kind. The patient also had generalized gingival recession and periodontal pockets in the posterior areas of her dentition. An asymmetric Angle Class III skeletal malocclusion created a posterior crossbite on the right side and an end-to-end incisal relationship. The dental midline was deviated and the maxillary and mandibular skeletal midlines were not coincident as evident in Fig 15.

The alveolar process of the mandibular incisors was extremely thin on both the buccal and lingual aspects. To correct these dento-skeletal deformities, periodontally selective decortication surgery was performed with DFDBA grafts in all areas of the maxillary alveolus so that the maxilla dental arch could be expanded. Periodontal surgery was also performed in the mandibular anterior alveolus from bicuspids to bicuspids to "thicken" the alveolar process by augmenting the facial-lingual dimension with bone and dense connective tissue on both the buccal and lingual aspects. Connective tissue grafts of Alloderm were placed from first molar to first molar on the labial aspects of the maxillary and mandibular teeth and on the lingual aspect of the mandibular anterior teeth. One can compare before and after photographs in Figs 15 and 16. The total treatment time in fixed appliances was 7 months. This treatment outcome was considered optimal since it was essential for efficient prosthodontic rehabilitation. The short treatment time was also optimal from a periodontal perspective because it minimized a concomitant bacterial load that becomes increasingly pathogenic with time.

**Case 8: Camouflage of Severe Skeletal Dysplasia (Fig 17)**

This patient presented with a mild Angle Class II skeletal relationship and a severe anterior overjet (Fig 17). All four of her second bicuspid teeth were congenitally missing. Since the patient had declined orthognathic surgery, her previous orthodontist had decided to leave the bilateral atrophic edentulous space in the maxillary second bicuspid areas untreated to ensure better lip support. The previous orthodontist considered that anterior teeth could not be proclined with conventional biomechanics without causing gingival recession. Others contend that the lower incisor should not be moved too far labial to B point, or more than 2 to 4 mm anterior to the cephalometric line joining A-Po. However, these traditional clinical guidelines are being questioned as the result of emerging periodontal standards, information presented in this article, and other recent orthodontic research.

The original treatment plan resulted in an anterior open bite with no anterior guidance in excursive mandibular movements. The latter situation requires for correction a combination of a standard orthodontic biomechanical protocol, bone grafting for implant site development, and augmentation of maxillary and mandibular anterior alveolus. This would then be followed by implant placement and both functional and cosmetic dental restoration.

The orthodontic brackets were placed and archwires activated 2 weeks before periodontal-orthodontic surgery. It was decided to open all second bicuspid dental spaces to 7 mm for implant site development. Bone grafting was performed on the labial alveolus to augment the edentulous second bicuspid areas. In Fig 19 note the bony dehiscences on the mandibular anterior teeth. Crown lengthening via osseous resection placed the periodontium at the correct relationship to the cemento-enamel junction. Perforation in the cortical plate was done at this first surgery. The maxillary anterior teeth were proclined.

**Figure 22.** Bony dehiscences and fenestrations can be discovered by cone beam volumetric computerized tomography in the initial records. These radiographs are similar to CT scans but have better resolution. If dehiscences or fenestrations are present in adults it would be wise to use periodontally accelerated osteogenic orthodontic augmentation before dental arch expansion to ensure that the alveolus form can accommodate dental arch expansion. (Color version of figure is available online.)
slightly to improve lip support and to develop the implant site at the edentulous maxillary second bicuspid areas. Due to the fact that no decorticating perforations were done (and hence there was no decalcification elicited) for the patient’s left mandibular molars (tooth numbers 18 and 19), they provided relative anchorage for midline correction and incisor protraction.

Several months passed to accomplish the above results and decalcification of the RAP dissipated significantly approximately 6 months after surgery. Selective decortication surgery and bone grafting was then performed on the patient’s mandibular left posterior alveolus to accelerate distalization of the molars, using the anterior dentition as the relative anchorage. An orthodontic microimplant was also placed in the retromolar area distal to the mandibular left second molar to provide absolute anchorage (Fig 20). After 4 to 5 weeks of healing and tooth movement, prosthetic implants were placed in the four bicuspid areas. Note the preprosthetic results in Fig 21. Prosthetic treatment will be
done to establish an esthetic and functionally physiologic mutually protected occlusion. See Figures 22 and 23 show the advantages of CBCT.

Conclusions

Since sophisticated treatment requires excellent communication, the interdisciplinary treatment described required treatment coordination between well-informed clinicians in a variety of fields. Although these procedures may seem daunting at first, repeated interdisciplinary collaboration results in very efficient protocols and execution that patients appreciate and benefit from. This author has, since the 1970s, enjoyed the fellowship and professional collaboration of orthodontists in a fruitful career and sustained professional enthusiasm with other colleagues. Hopefully this spirit of interdisciplinary collaboration (as demonstrated in Figure 18) will inspire readers to engage in their own interdisciplinary collaboration, and advance the frontiers of the orthodontic specialty’s scientific basis well into the 21st century.

References